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(1) I am fully conversant both with the Japanese and English languages.

(2) I have carefully compared the attached English language translation of Japanese Patent Application Number 132254/1997, filed May 22, 1997 with the original Japanese-language patent application.

(3) The translation is, to the best of my knowledge, and belief, an accurate translation from the original into the English language.

The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the matter with which this translation is used.

Date:

December 5, 2005

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PATENT OFFICE
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This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application: May 22, 1997

Application Number: Patent Application
No. 132254/1997

Applicant(s): HITACHI CHEMICAL CO., LTD.

May 29, 1998

Commissioner,
Patent Office: **Toshimitsu Arai**
(Sealed)

Certificate No.: 10-3040441

[Document name] APPLICATION FOR PATENT
[Reference number] 09102080
[Date of submission] May 22, 1997
[Addressee] Commissioner, Patent Office, Esq.
[Title of the invention] Process for preparing phosphor pattern
for field emission display panel, photo-
sensitive element for field emission
display panel, phosphor pattern for
field emission display panel and field
emission display panel
[Number of claim(s)] 12
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[Designation of fee]

[Prepayment file number] 010043

[Amount of payment] 21,000 yen

[List of documents submitted]

[Document name]	Specification	1
[Document name]	Drawing	1
[Document name]	Abstract	1
[General authoriza- tion number]	9701905	

[Proof] Required

[Document Name] Specification

[Title of the invention] Process for preparing phosphor pattern for field emission display panel, photosensitive element for field emission display panel, phosphor pattern for field emission display and field emission display

[Scope of claim for patent]

[Claim 1] A process for preparing a phosphor pattern for a field emission display which comprises the steps of: (I) forming (A) a photosensitive resin composition layer containing a phosphor on a substrate to which a conductive layer is formed,

(II) irradiating active light to (A) the photosensitive resin composition layer containing a phosphor with a predetermined image,

(III) selectively removing (A) the photosensitive resin composition layer containing a phosphor to which active light has been irradiated with a predetermined image by development to form a pattern, and

(IV) calcining the pattern to remove unnecessary portion to form a phosphor pattern.

[Claim 2] A process for preparing a phosphor pattern for a field emission display according to Claim 1, wherein the step (I) is

(Ia) a step of placing a photosensitive element having (A) a photosensitive resin composition layer containing a phosphor formed on a support film on the substrate to which a conductive layer is formed so as to contact (A) the photosensitive resin composition layer containing a phosphor with the substrate to which a conductive layer is formed and applying a pressure to (A) the photosensitive resin composition layer containing a phosphor to laminate (A) the photosensitive resin composition layer containing a phosphor on the substrate to which a conductive layer is formed.

[Claim 3] A process for preparing a phosphor pattern for a field emission display according to Claim 1, wherein the step (I) is

(Ib) a step of placing, on a substrate to which a conductive layer is formed, (B) a filling layer on (A) a photosensitive resin composition layer containing a phosphor and in such a state, applying a pressure to (B) the filling layer to laminate (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer on the substrate to which a conductive layer is formed, and

(Ic) a step of removing (B) the filling layer.

[Claim 4] A process for preparing a phosphor pattern for a field emission display according to Claim 3, wherein the step (I) is

(Ib') a step of placing a photosensitive element having (B) a filling layer on a support film and (A) a photosensitive resin composition layer containing a phosphor thereon on the substrate to which a conductive layer is formed so as to contact (A) the photosensitive resin composition layer containing a phosphor with the substrate to which a conductive layer is formed and applying a pressure to (B) the filling layer to laminate (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer on the substrate to which a conductive layer is formed, and

(Ic) a step of removing (B) the filling layer.

[Claim 5] A process for preparing a phosphor pattern for a field emission display according to Claim 1, 2, 3 or 4, wherein the respective steps of (I) to (III) are repeated to form a multi-colored pattern comprising photosensitive resin composition layer containing phosphors which are colored to red, green and blue, and then subjecting to the step of (IV) to form a multi-colored phosphor pattern.

[Claim 6] A process for preparing a phosphor pattern for a field emission display according to Claim 1, 2, 3 or 4, wherein the respective steps of (I) to (IV) are repeated to form a multi-colored pattern comprising photosensitive resin composition layer containing phosphors which are colored to red, green and blue.

[Claim 7] A process for preparing a phosphor pattern for

a field emission display according to Claim 1, 2, 3, 4, 5 or 6, wherein (A) the photosensitive resin composition layer containing a phosphor contains:

- (a) a film property-imparting polymer,
- (b) a photopolymerizable unsaturated compound having an ethylenically unsaturated group,
- (c) a photoinitiator forming a free radical by irradiation of active light, and
- (d) a phosphor.

[Claim 8] A photosensitive element for a field emission display having (A) a photosensitive resin composition layer containing a phosphor on a support film.

[Claim 9] A photosensitive element for a field emission display according to Claim 8, wherein the element has (B) a filling layer on a support film, and (A) a photosensitive resin composition layer containing a phosphor on (B) the filling layer.

[Claim 10] A phosphor pattern for a field emission display according to Claim 8 or 9, wherein (A) the photosensitive resin composition layer containing a phosphor contains:

- (a) a film property-imparting polymer,
- (b) a photopolymerizable unsaturated compound having an ethylenically unsaturated group,
- (c) a photoinitiator forming a free radical by irradiation of active light, and
- (d) a phosphor.

[Claim 11] A phosphor pattern for a field emission display which is prepared by the process according to Claim 1, 2, 3, 4, 5, 6 or 7.

[Claim 12] A field emission display which is provided with the phosphor pattern for a field emission display according to Claim 11.

[Detailed description of the invention]

[0001]

[Technical field to which the invention belongs]

This invention relates to a process for preparing phos-

phor pattern for a field emission display panel, a photosensitive element for a field emission display panel, a phosphor pattern for a field emission display and a field emission display.

[0002]

[Prior art]

As one of flat plate display panels, there has been known a field emission display (hereinafter referred to as FED) which enables multicolor display by providing a phosphor which emits light by colliding thereto electrons emitted from an electric field applied to a metal or semiconductor surface.

In recent years, accompanying with the progress of a semiconductor fine patterning technique, a number of fine field electron-emitting emitters can be formed on a Si wafer or a glass substrate with good reproducibility. According to this progress, field emission can be realized by applying a voltage with several ten volts without applying a high voltage.

FED is a display element in which a cathode substrate to which emitters are formed and an anode substrate to which a fluorescent surface is formed are opposed to each other in a vacuum sealed apparatus and which emits light by electron beam excitation.

FED can be called as a flat CRT having a number of plane electron guns on a flat plane, and in view of many advantages of a thickness of about 2 mm, spontaneous light displaying quality as that of CRT, a wide view filed angle of about 170°C, a quick response rate of μ sec order, environmental resistance as that of a vacuum tube and a low consumed power not more than TFT-LCD, it has been expected to use as a wide screen display panel.

[0003]

In the prior art, as a method for forming the phosphor, a method of coating a slurry liquid or a paste in which phosphors of the respective colors are dispersed is coated by a printing method such as screen printing has been proposed and

disclosed in Japanese Provisional Patent Publications No. 115027/1989, No. 124929/1989, No. 124930/1989, No. 155142/1990 and the like. It has also been known that an adhesive property of a specific portion is changed and a portion to which a phosphor is to be adhered is selected whereby three colors of R, G and B are separately formed.

However, the above-mentioned phosphor-dispersed slurry liquid is a liquid state so that dispersion failure is likely caused by sedimentation of phosphors, etc. Also, when a liquid state photosensitive resist is used as the slurry liquid, there is a defect that preservation stability is markedly lowered with the progress of dark reaction. Moreover, to cope with enlargement of a screen and making a fine pattern, these methods involve problems that they cannot realize uniformity in the screen in view of dimensional accuracy, mechanical precision and the like.

[0004]

[Problems to be solved by the invention]

An invention described in Claim 1 is to provide a process for producing a phosphor pattern for a field emission display in which a phosphor pattern for a field emission display can be formed on a substrate such as a substrate for forming a phosphor layer for a field emission display on which a conductive layer is formed with good mass productivity, high precision and uniform shape.

An invention described in Claim 2 is to provide a process for preparing a phosphor pattern for a field emission display with excellent workability and environmental safety in addition to the effects of the invention described in Claim 1.

An invention described in Claim 3 is to provide a process for preparing a phosphor pattern for a field emission display with higher precision and more uniform shape in addition to the effects of the invention described in Claim 1.

An invention described in Claim 4 is to provide a process for preparing a phosphor pattern for a field emission display with further excellent workability and environmental safety in

addition to the effects of the invention described in Claim 3.

[0005]

An invention described in Claim 5 is to provide a process for preparing a phosphor pattern for a field emission display with further excellent workability in addition to the effects of the inventions described in Claim 1, 2, 3 or 4.

An invention described in Claim 6 is to provide a process for producing a phosphor pattern for a field emission display which is more restrained from decreasing in a film thickness in addition to the effects of the inventions described in Claim 1, 2, 3 or 4.

An invention described in Claim 7 is to provide a process for producing a phosphor pattern for a field emission display with further excellent workability and photosensitivity in addition to the effects of the inventions described in Claim 1, 2, 3, 4, 5 or 6.

[0006]

An invention described in Claim 8 is to provide a photo-sensitive element for a field emission display which is excellent in restraint of edge fusion and handling property, and can form a phosphor pattern having high precision and uniform shape with good workability.

An invention described in Claim 9 is to provide a photo-sensitive element for a field emission display having higher precision and more uniform shape in addition to the effects of the invention described in Claim 8.

An invention described in Claim 10 is to provide a photo-sensitive element for a field emission display having more excellent workability and photosensitivity in addition to the effects of the inventions described in Claim 8 or 9.

An invention described in Claim 11 is to provide a phosphor pattern for a field emission display having high precision, uniform shape and excellent in luminance.

An invention described in Claim 12 is to provide a field emission display provided with a phosphor pattern for a field emission display having high precision, uniform shape and

excellent in luminance.

[0007]

[Means for solving the problems]

The first invention relates to a process for preparing a phosphor pattern for a field emission display which comprises the steps of:

(I) forming (A) a photosensitive resin composition layer containing a phosphor on a substrate to which a conductive layer is formed,

(II) irradiating active light to (A) the photosensitive resin composition layer containing a phosphor with a predetermined image,

(III) selectively removing (A) the photosensitive resin composition layer containing a phosphor to which active light has been irradiated with a predetermined image by development to form a pattern, and

(IV) calcining the pattern to remove unnecessary portion to form a phosphor pattern.

[0008]

Also, the present invention relates to a process for preparing a phosphor pattern for a field emission display, wherein the step (I) is

(Ia) a step of placing a photosensitive element having (A) a photosensitive resin composition layer containing a phosphor formed on a support film on the substrate to which a conductive layer is formed so as to contact (A) the photosensitive resin composition layer containing a phosphor with the substrate to which a conductive layer is formed and applying a pressure to (A) the photosensitive resin composition layer containing a phosphor to laminate (A) the photosensitive resin composition layer containing a phosphor on the substrate to which a conductive layer is formed.

[0009]

Also, the present invention relates to a process for preparing a phosphor pattern for a field emission display, wherein the step (I) is

(Ib) a step of placing, on a substrate to which a conductive layer is formed, (B) a filling layer on (A) a photosensitive resin composition layer containing a phosphor and in such a state, applying a pressure to (B) the filling layer to laminate (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer on the substrate to which a conductive layer is formed, and

(Ic) a step of removing (B) the filling layer.

Also, the present invention relates to a process for preparing a phosphor pattern for a field emission display, wherein the step (I) is

(Ib') a step of placing a photosensitive element having (B) a filling layer on a support film and (A) a photosensitive resin composition layer containing a phosphor thereon on the substrate to which a conductive layer is formed so as to contact (A) the photosensitive resin composition layer containing a phosphor with the substrate to which a conductive layer is formed and applying a pressure to (B) the filling layer to laminate (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer on the substrate to which a conductive layer is formed, and

(Ic) a step of removing (B) the filling layer.

[0010]

Also, the present invention relates to a process for preparing a phosphor pattern for a field emission display panel, wherein the respective steps of (I) to (III) are repeated to form a multi-colored pattern comprising photosensitive resin composition layer containing phosphors which are colored to red, green and blue, and then subjecting to the step of (IV) to form a multi-colored phosphor pattern.

Also, the present invention relates to a process for preparing a phosphor pattern for a field emission display panel, wherein the respective steps of (I) to (IV) are repeated to form a multi-colored pattern comprising photosensitive resin composition layer containing phosphors which are colored to red, green and blue.

Also, the present invention relates to a process for preparing a phosphor pattern for a field emission display panel, wherein (A) the photosensitive resin composition layer containing a phosphor contains:

- (a) a film property-imparting polymer,
- (b) a photopolymerizable unsaturated compound having an ethylenically unsaturated group,
- (c) a photoinitiator forming a free radical by irradiation of active light, and
- (d) a phosphor.

[0011]

Also, the present invention relates to a photosensitive element for a field emission display having (A) a photosensitive resin composition layer containing a phosphor on a support film.

Also, the present invention relates to a photosensitive element for a field emission display panel, wherein the element has (B) a filling layer on a support film, and (A) a photosensitive resin composition layer containing a phosphor on (B) the filling layer.

Also, the present invention relates to a phosphor pattern for a field emission display panel, wherein (A) the photosensitive resin composition layer containing a phosphor contains:

- (a) a film property-imparting polymer,
- (b) a photopolymerizable unsaturated compound having an ethylenically unsaturated group,
- (c) a photoinitiator forming a free radical by irradiation of active light, and
- (d) a phosphor.

Also, the present invention relates to a phosphor pattern for a field emission display which is prepared by the above-mentioned processes for preparing a phosphor pattern for a field emission display.

Also, the present invention relates to a field emission display which is provided with the phosphor pattern for a field emission display.

[0012]

[Embodiments of the invention]

A process for preparing a phosphor pattern for a field emission display of the present invention comprises the steps of: (I) forming (A) a photosensitive resin composition layer containing a phosphor on a substrate onto which a conductive layer is formed, (II) irradiating active light to (A) the photosensitive resin composition layer containing a phosphor with a predetermined image, (III) selectively removing (A) the photosensitive resin composition layer containing a phosphor to which active light has been irradiated with a predetermined image by development to form a pattern, and (IV) calcining the pattern to remove unnecessary portion to form a phosphor pattern.

[0013]

As the substrate on which a conductive layer is formed in the present invention, there may be mentioned, for example, a substrate comprising an inorganic material such as a glass plate, an alumina plate, a ceramics plate, a metal substrate (aluminum, copper, nickel, stainless, etc.) and the like, or a substrate comprising an organic material such as a synthetic resin plate, and the like, as well as a substrate on which a conductive layer comprising a graphite, metal, alloy or metal oxide film is formed, all of which may be subjected to a surface treatment for adhesion.

A conductive layer comprising a metal, alloy or metal oxide (such as aluminum, copper, silver, gold, nickel, chromium, molybdenum, tungsten, platinum, titanium, palladium, ruthenium dioxide, palladium-silver alloy, indium-tin oxide, etc.) film is not particularly limited, and can be formed by subjecting a material containing metal or metal oxide to deposition, sputtering, plating, coating, printing, etc.

Such a substrate on which a conductive layer is formed can be used as a substrate for forming a phosphor layer of a field emission display.

[0014]

In Fig. 1 and Fig. 2, partial schematic views as one example of substrates for forming a FED phosphor layer are shown.

Fig. 1 is a substrate for forming a phosphor layer to be used as a front plate of a transmission type FED, while Fig. 2 is a substrate for forming a phosphor layer to be used as an intermediate plate of a reflection type FED. Incidentally, in Fig. 1 and Fig. 2, the reference numeral 1 is a substrate for forming a FED phosphor layer, and 2 is a conductive layer.

[0015]

As (A) the photosensitive resin composition layer containing a phosphor in the present invention, the composition is not particularly limited and can be constituted by a photosensitive resin composition generally used in the photolithographic method. In view of photosensitivity and workability, those containing (a) a film property-imparting polymer, (b) a photopolymerizable unsaturated compound having an ethylenically unsaturated group, (c) a photoinitiator forming a free radical by irradiation of active light, and (d) a phosphor are preferred.

[0016]

As (a) the film property-imparting polymer in the present invention, a vinyl copolymer is preferred. As a vinyl monomer to be used in the vinyl copolymer, there may be mentioned, for example, acrylic acid, methacrylic acid, maleic acid, fumaric acid, itaconic acid, methyl acrylate, methyl methacrylate, ethyl acrylate, ethyl methacrylate, n-propyl acrylate, n-propyl methacrylate, iso-propyl acrylate, iso-propyl methacrylate, n-butyl acrylate, n-butyl methacrylate, iso-butyl acrylate, iso-butyl methacrylate, sec-butyl acrylate, sec-butyl methacrylate, tert-butyl acrylate, tert-butyl methacrylate, pentyl acrylate, pentyl methacrylate, hexyl acrylate, hexyl methacrylate, heptyl acrylate, heptyl methacrylate, 2-ethylhexyl acrylate, 2-ethylhexyl methacrylate, octyl acrylate, octyl methacrylate, nonyl acrylate, nonyl methacrylate, decyl acrylate, decyl methacrylate, dodecyl acrylate, dodecyl

methacrylate, tetradecyl acrylate, tetradecyl methacrylate, hexadecyl acrylate, hexadecyl methacrylate, octadecyl acrylate, octadecyl methacrylate, eicosyl acrylate, eicosyl methacrylate, docosyl acrylate, docosyl methacrylate, cyclopentyl acrylate, cyclopentyl methacrylate, cyclohexyl acrylate, cyclohexyl methacrylate, cycloheptyl acrylate, cycloheptyl methacrylate, benzyl acrylate, benzyl methacrylate, phenyl acrylate, phenyl methacrylate, methoxyethyl acrylate, methoxyethyl methacrylate, diethylene glycol methoxy acrylate, diethylene glycol methoxy methacrylate, dipropylene glycol methoxy acrylate, dipropylene glycol methoxy methacrylate, triethylene glycol methoxy acrylate, triethylene glycol methoxy methacrylate, 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate, dimethylaminoethyl acrylate, dimethylaminoethyl methacrylate, diethylaminoethyl acrylate, diethylaminoethyl methacrylate, dimethylaminopropyl acrylate, dimethylaminopropyl methacrylate, 2-chloroethyl acrylate, 2-chloroethyl methacrylate, 2-fluoroethyl acrylate, 2-fluoroethyl methacrylate, 2-cyanoethyl acrylate, 2-cyanoethyl methacrylate, styrene, α -methylstyrene, vinyltoluene, vinyl chloride, vinyl acetate, N-vinyl pyrrolidone, butadiene, isoprene, chloroprene, acrylamide, methacrylamide, acrylonitrile, methacrylonitrile, etc. These monomers are used singly or in combination of two or more of them.

[0017]

The weight average molecular weight of (a) the film property-imparting polymer in the present invention is preferably 5,000 to 300,000, more preferably 20,000 to 150,000. If the weight average molecular weight is less than 5,000, film-forming property and flexibility tend to be lowered when a photosensitive element is prepared, while if it exceeds 300,000, developability (property that an unnecessary portion can be easily removed by development) tends to be lowered.

Incidentally, the weight average molecular weight is a value measured by the gel permeation chromatography method and calculated by using a standard polystyrene calibration curve.

[0018]

Also, in order that (A) the phosphor-containing photo-sensitive resin composition layer can be developed by known various developing solutions, the carboxyl group content (which can be regulated by an acid value (mgKOH/g)) of (a) the film property-imparting polymer can be adjusted suitably.

For example, when development is carried out by using an aqueous alkali solution of sodium carbonate, potassium carbonate or the like, the acid value is preferably set to 90 to 260. If the acid value is less than 90, development tends to be difficult, while if it exceeds 260, developing solution resistance (property that a portion which remains without being removed by development and becomes a pattern is not corroded by a developing solution) tends to be lowered.

Also, when development is carried out by using an aqueous developing solution comprising water or an aqueous alkali solution and at least one organic solvent, the acid value is preferably made 16 to 260. If the acid value is less than 16, development tends to be difficult, while if it exceeds 260, developing solution resistance tends to be lowered.

Further, when development is carried out by using a developing solution (an emulsion developing solution) comprising water and at least one organic solvent which is not dissolved in water and when an organic solvent developing solution such as 1,1,1-trichloroethane is used, no carboxyl group may be contained.

[0019]

As (b) the photopolymerizable unsaturated compound having an ethylenically unsaturated group in the present invention, there may be used all compounds which have been conventionally known as a photopolymerizable polyfunctional monomer.

[0020]

For example, there may be mentioned a compound represented by the following formula (I):

[Formula 1]

(wherein R represents a hydrogen atom or a methyl group, k represents an integer of 1 to 10, and Y represents a saturated or unsaturated hydrocarbon residue or heterocyclic residue which may have a substituent(s), or a polyalkylene glycol residue,

[Formula 2]

(wherein R¹ and R² each independently represents a hydrogen atom, a methyl group, an ethyl group, a propyl group or a trifluoromethyl group, R³ and R⁴ each independently represents an alkylene group having 1 to 6 carbon atoms, and m and n each independently represent an integer of 1 to 20.)).

[0021]

In the formula (I), as the saturated or unsaturated hydrocarbon residue or heterocyclic residue which may have a substituent(s) represented by Y, there may be mentioned, for example, a straight, branched or alicyclic alkane residue having 1 to 22 carbon atoms, which may have a substituent(s) such as a halogen atom, a hydroxyl group, an amino group and a carboxyl group (e.g., a methane residue, an ethane residue, a propane residue, a cyclopropane residue, a butane residue, an isobutane residue, a cyclobutane residue, a pentane residue, an isopentane residue, a neopentane residue, a cyclopentane residue, a hexane residue, a cyclohexane residue, a heptane residue, a cycloheptane residue, an octane residue, a nonane residue and a decane residue), an aromatic cyclic residue (e.g., a benzene residue, a naphthalene residue, an anthracene residue, a biphenyl residue and a terphenyl residue) and a heterocyclic residue (e.g., a furan residue, a thiophene residue, a pyrrole residue, an oxazole residue, a thiazole residue, an imidazole residue, a pyridine residue, a pyrimi-

dine residue, a pyrazine residue, a triazine residue, a quinoline residue and a quinoxaline residue), and the like.

[0022]

Specifically, as a monomer having one unsaturated bond, there may be mentioned, for example, an ester type monomer of acrylic acid or methacrylic acid (e.g., methyl acrylate, methyl methacrylate, ethyl acrylate, ethyl methacrylate, n-propyl acrylate, n-propyl methacrylate, iso-propyl acrylate, iso-propyl methacrylate, n-butyl acrylate, n-butyl methacrylate, iso-butyl acrylate, iso-butyl methacrylate, sec-butyl acrylate, sec-butyl methacrylate, tert-butyl acrylate, tert-butyl methacrylate, pentyl acrylate, pentyl methacrylate, hexyl acrylate, hexyl methacrylate, heptyl acrylate, heptyl methacrylate, 2-ethylhexyl acrylate, 2-ethylhexyl methacrylate, octyl acrylate, octyl methacrylate, nonyl acrylate, nonyl methacrylate, decyl acrylate, decyl methacrylate, dodecyl acrylate, dodecyl methacrylate, tetradecyl acrylate, tetradecyl methacrylate, hexadecyl acrylate, hexadecyl methacrylate, octadecyl acrylate, octadecyl methacrylate, eicosyl acrylate, eicosyl methacrylate, docosyl acrylate, docosyl methacrylate, cyclopentyl acrylate, cyclopentyl methacrylate, cyclohexyl acrylate, cyclohexyl methacrylate, cycloheptyl acrylate, cycloheptyl methacrylate, benzyl acrylate, benzyl methacrylate, phenyl acrylate, phenyl methacrylate, methoxyethyl acrylate, methoxyethyl methacrylate, dimethylaminoethyl acrylate, dimethylaminoethyl methacrylate, dimethylaminopropyl acrylate, dimethylaminopropyl methacrylate, 2-chloroethyl acrylate, 2-chloroethyl methacrylate, 2-fluoroethyl acrylate, 2-fluoroethyl methacrylate, 2-cyanoethyl acrylate, 2-cyanoethyl methacrylate, diethylene glycol methoxy acrylate, diethylene glycol methoxy methacrylate, dipropylene glycol methoxy acrylate, dipropylene glycol methoxy methacrylate, triethylene glycol methoxy acrylate and triethylene glycol methoxy methacrylate), a styrene type monomer (e.g., styrene, α -methylstyrene and p-t-butylstyrene), a polyolefin type monomer (e.g., butadiene, isoprene and chloroprene), a vinyl

type monomer (e.g., vinyl chloride and vinyl acetate), a nitrile type monomer (e.g., acrylonitrile and methacrylonitrile) and 1-(methacryloyloxyethoxycarbonyl)-2-(3'-chloro-2'-hydroxypropoxycarbonyl)benzene.

[0023]

As a monomer having two unsaturated bonds, there may be mentioned, for example, ethylene glycol diacrylate, ethylene glycol dimethacrylate, diethylene glycol diacrylate, diethylene glycol dimethacrylate, triethylene glycol diacrylate, triethylene glycol dimethacrylate, tetraethylene glycol diacrylate, tetraethylene glycol dimethacrylate, polyethylene glycol diacrylate, polyethylene glycol dimethacrylate, hexapropylene glycol diacrylate, hexapropylene glycol dimethacrylate, polypropylene glycol diacrylate, polypropylene glycol dimethacrylate, butylene glycol diacrylate, butylene glycol dimethacrylate, neopentyl glycol diacrylate, neopentyl glycol dimethacrylate, 1,3-butanediol diacrylate, 1,3-butanediol dimethacrylate, 1,4-butanediol diacrylate, 1,4-butanediol dimethacrylate, 1,5-pentanediol diacrylate, 1,5-pentanediol dimethacrylate, 1,6-hexanediol diacrylate, 1,6-hexanediol dimethacrylate, pentaerythritol diacrylate, pentaerythritol dimethacrylate, trimethylolpropane diacrylate, trimethylolpropane dimethacrylate, bisphenol A diacrylate, bisphenol A dimethacrylate, 2,2-bis(4-acryloxyethoxyphenyl)propane, 2,2-bis(4-methacryloxyethoxyphenyl)propane, 2,2-bis(4-acryloxydiethoxyphenyl)propane, 2,2-bis(4-methacryloxydiethoxyphenyl)propane, 2,2-bis(4-acryloxypolyethoxyphenyl)propane, 2,2-bis(4-methacryloxypolyethoxyphenyl)propane (in the formula (I), Y is

[Formula 3]

(wherein m and n each independently represent an integer of 1 to 20)), bisphenol A diglycidyl ether diacrylate, bisphenol A diglycidyl ether dimethacrylate and a urethane diacrylate

compound.

[0024]

As a monomer having three unsaturated bonds, there may be mentioned, for example, trimethylolpropane triacrylate, trimethylolpropane trimethacrylate, pentaerythritol triacrylate, pentaerythritol trimethacrylate, ethylene oxide-modified trimethylolpropane triacrylate, ethylene oxide-modified trimethylolpropane trimethacrylate, trimethylolpropane triglycidyl ether triacrylate and trimethylolpropane triglycidyl ether trimethacrylate.

As a monomer having four unsaturated bonds, there may be mentioned, for example, tetramethylolpropane tetraacrylate, tetramethylolpropane tetramethacrylate, pentaerythritol tetraacrylate and pentaerythritol tetramethacrylate.

[0025]

As a monomer having five unsaturated bonds, there may be mentioned, for example, dipentaerythritol pentaacrylate and dipentaerythritol pentamethacrylate.

As a monomer having six unsaturated bonds, there may be mentioned, for example, dipentaerythritol hexaacrylate and dipentaerythritol hexamethacrylate.

Any of these monomers having an unsaturated bond(s) may be used so long as radical polymerization can be effected by irradiation of light, and these monomers having an unsaturated bond(s) are used singly or in combination of two or more of them.

[0026]

Also, in (A) the photosensitive resin composition layer containing a phosphor of the present invention, it is necessary to remove unnecessary components by calcination when a phosphor pattern is prepared so that among the above photopolymerizable unsaturated compounds (b) having an ethylenically unsaturated group, preferably used is polyethylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate or poly(ethylene-propylene) glycol di(meth)acrylate each having good thermal decomposition property.

[0027]

Also, when a photosensitive element described below is prepared by using (A) the photosensitive resin composition layer containing a phosphor and from the point that storage stability after embedding in the space of the substrate for PDP described below (property that (b) the photopolymerizable unsaturated compound having an ethylenically unsaturated group in (A) the photosensitive resin composition layer containing a phosphor is migrated into the thermoplastic resin layer (B) described below is suppressed) can be improved and the point that at the time of heating under reduced pressure when the phosphor-containing photosensitive resin composition layer (A) is embedded in the space of the substrate for PDP described below, evaporation of (b) the photopolymerizable unsaturated compound having an ethylenically unsaturated group in (A) the photosensitive resin composition layer containing a phosphor can be suppressed, the weight average molecular weight of (b) the photopolymerizable unsaturated compound having an ethylenically unsaturated group is preferably 400 or more, more preferably 500 or more, particularly preferably 600 or more. Also, the boiling point (760 mmHg) of (b) the photopolymerizable unsaturated compound having an ethylenically unsaturated group is not particularly limited so long as it is 300°C or higher. However, from the points of stability and operability when heating is carried out under reduced pressure, the boiling point (760 mmHg) is preferably 350°C or higher, more preferably 400°C or higher.

[0028]

(b) The photopolymerizable unsaturated compound having an ethylenically unsaturated group, having a weight average molecular weight of 400 or more or (b) the photopolymerizable unsaturated compound having an ethylenically unsaturated group, having a boiling point (760 mmHg) of 300°C or higher may be selected from, for example, photopolymerizable unsaturated compounds shown below.

[0029]

As a monomer having one unsaturated bond, there may be mentioned, for example, an ester type monomer of acrylic acid or methacrylic acid (polyethylene glycol acrylate (the number of ethylene oxides is 9 to 50), polyethylene glycol methacrylate (the number of ethylene oxides is 9 to 50), methoxypolyethylene glycol acrylate (the number of ethylene oxides is 9 to 50), methoxypolyethylene glycol methacrylate (the number of ethylene oxides is 9 to 50), methoxypolypropylene glycol acrylate (the number of propylene oxides is 7 to 40), methoxypolypropylene glycol methacrylate (the number of propylene oxides is 7 to 40) or the like), a styrene type monomer, a polyolefin type monomer, a vinyl type monomer and a nitrile type monomer.

[0030]

As a monomer having two unsaturated bonds, there may be mentioned, for example, polyethylene glycol diacrylate (the number of ethylene oxides is 9 to 50), polyethylene glycol dimethacrylate (the number of ethylene oxides is 9 to 50), hexapropylene glycol diacrylate, hexapropylene glycol dimethacrylate, polypropylene glycol diacrylate (the number of propylene oxides is 7 to 40), polypropylene glycol dimethacrylate (the number of propylene oxides is 7 to 40), polyethylene glycol polypropylene glycol diacrylate (the total number of ethylene oxides and propylene oxides is 7 to 50), polyethylene glycol polypropylene glycol dimethacrylate (the total number of ethylene oxides and propylene oxides is 7 to 50), 2,2-bis(4-acryloxydiethoxyphenyl)propane, 2,2-bis(4-methacryloxydiethoxyphenyl)propane, 2,2-bis(4-acryloxypolyethoxyphenyl)propane, 2,2-bis(4-methacryloxypolyethoxyphenyl)propane, bisphenol A diglycidyl ether diacrylate, bisphenol A diglycidyl ether dimethacrylate and a urethane diacrylate compound such as a reaction product of trimethylhexamethylene diisocyanate/cyclohexanedimethanol/2-hydroxyethyl acrylate (a molar ratio of 2/1/2).

[0031]

As a monomer having three unsaturated bonds, there may be

mentioned, for example, propylene oxide-modified trimethylolpropane trimethacrylate and alkyl-modified dipentaerythritol triacrylate.

As a monomer having four unsaturated bonds, there may be mentioned, for example, ditrimethylolpropane tetramethacrylate, alkyl-modified dipentaerythritol tetraacrylate, alkyl-modified dipentaerythritol tetramethacrylate, ethylene oxide-modified pentaerythritol tetraacrylate and ethylene oxide-modified pentaerythritol tetramethacrylate.

As a monomer having five unsaturated bonds, there may be mentioned, for example, dipentaerythritol pentaacrylate, dipentaerythritol pentamethacrylate, dipentaerythritol monohydroxypentaacrylate, dipentaerythritol monohydroxypentamethacrylate and alkyl-modified dipentaerythritol pentaacrylate.

As a monomer having six unsaturated bonds, there may be mentioned, for example, dipentaerythritol hexaacrylate and dipentaerythritol hexamethacrylate.

These monomers are used singly or in combination of two or more of them.

[0032]

Also, when preparing a phosphor pattern mentioned hereinbelow, unnecessary portion shall be removed by calcination. Thus, among the photosensitive resin composition constituting (A) the photosensitive resin composition layer containing a phosphor according to the present invention, the photosensitive resin composition other than (d) a phosphor and a binder is required to have good thermal decomposition property. Therefore, it is preferred that the photosensitive resin composition other than (d) a phosphor and a binder shall not contain elements other than carbon, hydrogen, oxygen and nitrogen as elements constituting the same.

[0033]

Also, as a compound having both of the functions of (a) the film property-imparting polymer and (b) the photopolymerizable unsaturated compound having an ethylenically unsaturated group at the terminal, a photopolymerizable polymer

binder having an ethylenically unsaturated group at the side chain may be used in place of (a) the film property-imparting polymer. More specifically, there may be mentioned a photopolymerizable vinyl copolymer obtained by subjecting a compound having at least one ethylenically unsaturated group and one functional group such as an oxirane ring, an isocyanate group, a hydroxyl group, a carboxyl group, etc., to addition reaction with a vinyl copolymer having a functional group such as a carboxyl group, a hydroxyl group, an amino group, an isocyanate group, an oxirane ring, an acid anhydride, etc.

[0034]

As a vinyl monomer to be used in synthesis of the vinyl copolymer having a functional group such as a carboxyl group, a hydroxyl group, an amino group, an oxirane ring, an acid anhydride, etc., there may be mentioned, for example, a vinyl monomer having a functional group such as a carboxyl group, a hydroxyl group, an amino group, an oxirane ring and an acid anhydride, such as acrylic acid, methacrylic acid, maleic acid, fumaric acid, itaconic acid, cinnamic acid, 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate, acrylamide, methacrylamide, isocyanate-ethyl methacrylate, glycidyl acrylate, glycidyl methacrylate and maleic anhydride. As other vinyl monomer, there may be mentioned, for example, methyl acrylate, methyl methacrylate, ethyl acrylate, ethyl methacrylate, n-propyl acrylate, n-propyl methacrylate, isopropyl acrylate, iso-propyl methacrylate, n-butyl acrylate, n-butyl methacrylate, iso-butyl acrylate, iso-butyl methacrylate, sec-butyl acrylate, sec-butyl methacrylate, tert-butyl acrylate, tert-butyl methacrylate, pentyl acrylate, pentyl methacrylate, hexyl acrylate, hexyl methacrylate, heptyl acrylate, heptyl methacrylate, 2-ethylhexyl acrylate, 2-ethylhexyl methacrylate, octyl acrylate, octyl methacrylate, nonyl acrylate, nonyl methacrylate, decyl acrylate, decyl methacrylate, dodecyl acrylate, dodecyl methacrylate, tetradecyl acrylate, tetradecyl methacrylate, hexadecyl acrylate, hexadecyl methacrylate, octadecyl acrylate, octadecyl meth-

acrylate, eicosyl acrylate, eicosyl methacrylate, docosyl acrylate, docosyl methacrylate, cyclopentyl acrylate, cyclopentyl methacrylate, cyclohexyl acrylate, cyclohexyl methacrylate, cycloheptyl acrylate, cycloheptyl methacrylate, benzyl acrylate, benzyl methacrylate, phenyl acrylate, phenyl methacrylate, methoxyethyl acrylate, methoxyethyl methacrylate, diethylene glycol methoxy acrylate, diethylene glycol methoxy methacrylate, dipropylene glycol methoxy acrylate, dipropylene glycol methoxy methacrylate, triethylene glycol methoxy acrylate, triethylene glycol methoxy methacrylate, dimethylaminoethyl acrylate, dimethylaminoethyl methacrylate, diethylaminoethyl acrylate, diethylaminoethyl methacrylate, dimethylaminopropyl acrylate, dimethylaminopropyl methacrylate, 2-chloroethyl acrylate, 2-chloroethyl methacrylate, 2-fluoroethyl acrylate, 2-fluoroethyl methacrylate, 2-cyanoethyl acrylate, 2-cyanoethyl methacrylate, styrene, α -methylstyrene, vinyl toluene, vinyl chloride, vinyl acetate, N-vinyl pyrrolidone, butadiene, isoprene, chloroprene, acrylonitrile and methacrylonitrile. These monomers are used singly or in combination of two or more of them with the vinyl monomer having a functional group such as a carboxyl group, a hydroxyl group, an amino group, an oxirane ring and an acid anhydride being an indispensable component.

[0035]

As the compound having at least one ethylenically unsaturated group and one functional group such as an oxirane ring, an isocyanate group, a hydroxyl group, a carboxyl group, an amino group, an acid anhydride, etc., there may be mentioned, for example, glycidyl acrylate, glycidyl methacrylate, ethyl isocyanate methacrylate, 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate, acrylic acid, methacrylic acid, maleic acid, fumaric acid, itaconic acid, cinnamic acid, acrylamide, methacrylamide and maleic anhydride. These compounds are used singly or in combination of two or more of them.

[0036]

The weight average molecular weight of the photopolymerizable polymer binder having an ethylenically unsaturated group at the side chain of the present invention is preferably 5,000 to 300,000, more preferably 20,000 to 150,000. If the weight average molecular weight is less than 5,000, film-forming property and flexibility tend to be lowered when a photosensitive element is prepared, while if it exceeds 300,000, developability (property that an unnecessary portion can be easily removed by development) tends to be lowered.

[0037]

Also, in order that (A) the phosphor-containing photosensitive resin composition layer can be developed by known various developing solutions, the carboxyl group content (which can be regulated by an acid value (mgKOH/g)) of photopolymerizable polymer binder having an ethylenically unsaturated group at the side chain can be adjusted suitably.

For example, when development is carried out by using an aqueous alkali solution of sodium carbonate, potassium carbonate or the like, the acid value is preferably set to 90 to 260. If the acid value is less than 90, development tends to be difficult, while if it exceeds 260, developing solution resistance (property that a portion which remains without being removed by development and becomes a pattern is not corroded by a developing solution) tends to be lowered.

Also, when development is carried out by using an aqueous developing solution comprising water or an aqueous alkali solution and at least one organic solvent, the acid value is preferably made 16 to 260. If the acid value is less than 16, development tends to be difficult, while if it exceeds 260, developing solution resistance tends to be lowered.

Further, when an organic solvent developing solution such as 1,1,1-trichloroethane, or an emulsion developing solution is used, no carboxyl group may be contained.

[0038]

As (c) the photopolymerization initiator which produces free radical by irradiation of active light in the present

invention, there may be mentioned, for example, an aromatic ketone (e.g., benzophenone, N,N'-tetramethyl-4,4'-diaminobenzophenone (Michler's ketone), N,N'-tetraethyl-4,4'-diaminobenzophenone, 4-methoxy-4'-dimethylaminobenzophenone, 1-hydroxy-cyclohexyl-phenyl-ketone, 2,4-diethylthioxanthone, 2-ethylanthraquinone and phenanthrenequinone), a benzoin ether (e.g., benzoin methyl ether, benzoin ethyl ether and benzoin phenyl ether), a benzoin (e.g., methyl benzoin and ethyl benzoin), a benzyl derivative (e.g., 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butanone-1, 2-methyl-1-(4-(methylthio)-phenyl)-2-morpholinopropanone-1, 2,2-dimethoxy-1,2-diphenylethan-1-one and benzyldimethylketal), a 2,4,5-triarylimidazole dimer (e.g., a 2-(o-chlorophenyl)-4,5-diphenylimidazole dimer, a 2-(o-chlorophenyl)-4,5-di(m-methoxyphenyl)imidazole dimer, a 2-(o-fluorophenyl)-4,5-phenylimidazole dimer, a 2-(o-methoxyphenyl)-4,5-diphenylimidazole dimer, a 2-(p-methoxyphenyl)-4,5-diphenylimidazole dimer, a 2,4-di(p-methoxyphenyl)-5-phenylimidazole dimer and a 2-(2,4-dimethoxyphenyl)-4,5-diphenylimidazole dimer) and an acridine derivative (e.g., 9-phenylacridine and 1,7-bis(9,9'-acridinyl)heptane). These photopolymerization initiators are used singly or in combination of two or more of them.

[0039]

As (d) the phosphor in the present invention, it is not particularly limited and those mainly comprising metal oxide or metal sulfide conventionally used can be used.

As a phosphor which emits red light, there may be mentioned, for example, $Y_2O_2S:Eu$, $Zn_3(PO_4)_2:Mn$, $Y_2O_3:Eu$, $YVO_4:Eu$, $(Y,Gd)BO_3:Eu$, $\gamma-Zn_3(PO_4)_2:Mn$, $(ZnCd)S:Ag$, $(ZnCd)S:Ag+In_2O_3$, Fe_2O_3 attached- $Y_2O_2S:Eu$, etc.

As a phosphor which emits green light, there may be mentioned, for example, $ZnS:Cu$, $Zn_2SiO_4:Mn$, $ZnS:Cu+Zn_2SiO_4:Mn$, $Gd_2O_2S:Tb$, $Y_3Al_5O_{12}:Ce$, $ZnS:Cu,Al$, $Y_2O_2S:Tb$, $ZnO:Zn$, $ZnS:Cu,Al+In_2O_3$, $LaPO_4:Ce,Tb$, $BaO \cdot 6Al_2O_3:Mn$, $(Zn,Cd)S:Ag$, $(Zn,Cd)S:Cu,Al$, $ZnS:Cu,Au,Al$, $Y_3(Al,Ga)_2O_{12}:Tb$, $Y_2SiO_5:Tb$, $LaOCl:Tb$, etc.

As a phosphor which emits blue light, there may be men-

tioned, for example, ZnS:Ag, ZnS:Ag,Al, ZnS:Ag,Ga,Al, ZnS:Ag,Cu,Ga,Cl, ZnS:Ag+In₂O₃, Ca₂B₅O₉Cl:Eu²⁺, (Sr,Ca,Ba,Mg)₁₀(PO₄)₆Cl₂:Eu²⁺, Sr₁₀(PO₄)₆Cl₁₂:Eu²⁺, BaMgAl₁₀O₁₇:Eu²⁺, BaMgAl₁₄O₂₃:Eu²⁺, BaMgAl₁₆O₂₆:Eu²⁺, CoO and Al₂O₃ attached-ZnS:Ag, ZnS:Ag,Ga, etc.

[0040]

The particle size of (d) the phosphor in the present invention is preferably 0.1 to 20 μm, more preferably 1 to 15 μm, and particularly preferably 2 to 8 μm. If the particle size is less than 0.1 μm, emission efficiency tends to be lowered, while if it exceeds 20 μm, dispersibility tends to be lowered.

The shape of (d) the phosphor of the present invention is preferably spherical, and the surface area is preferably as small as possible.

[0041]

A formulation amount of the above-mentioned Component (a) in the present invention is preferably 10 to 90 parts by weight, more preferably 20 to 80 parts by weight based on the total weight of Component (a) and Component (b) as 100 parts by weight. If the formulation amount is less than 10 parts by weight, when it is supplied in a roll state as a photosensitive element, the photosensitive resin composition is exuded from the edge portion of the roll (hereinafter referred to as edge fusion) so that the roll can hardly be dispatched when laminating the photosensitive element, or there is a tendency of lowering in film-forming property. If it exceeds 90 parts by weight, sensitivity tends to be insufficient.

[0042]

A formulation amount of the above-mentioned Component (b) in the present invention is preferably 10 to 90 parts by weight, more preferably 20 to 80 parts by weight based on the total weight of Component (a) and Component (b) as 100 parts by weight. If the formulation amount is less than 10 parts by weight, sensitivity of the photosensitive resin composition tends to be insufficient, while if it exceeds 90 parts by weight, the photocured product tends to be brittle, and when a

photosensitive element is prepared, the photosensitive resin composition is exuded from the edge portion due to its fluidity or a film-forming property tends to be lowered.

[0043]

A formulation amount of the above-mentioned Component (c) in the present invention is preferably 0.01 to 30 parts by weight, more preferably 0.1 to 20 parts by weight based on the total weight of Component (a) and Component (b) as 100 parts by weight. If the formulation amount is less than 0.01 part by weight, sensitivity of the photosensitive resin composition tends to be insufficient, while if it exceeds 30 parts by weight, absorption of an active light at the exposed surface of the photosensitive resin composition is increased whereby photocuring at the inner portion tends to be insufficient.

[0044]

A formulation amount of the above-mentioned Component (d) in the present invention is preferably 10 to 400 parts by weight, more preferably 50 to 350 parts by weight, particularly preferably 70 to 300 parts by weight based on the total weight of Component (a), Component (b) and Component (c) as 100 parts by weight. If the formulation amount is less than 10 parts by weight, when it is emitted, emission efficiency tends to be lowered, while if it exceeds 400 parts by weight, when it is prepared as a photosensitive element, a film-forming property is lowered or flexibility tends to be lowered.

[0045]

In the photosensitive resin composition constituting (A) the photosensitive resin composition layer containing a phosphor of the present invention, a plasticizer may be added to improve a film-forming property.

As the plasticizer, there may be mentioned a polyalkylene glycol derivative such as a polypropylene glycol represented by the formula (II):

[Formula 4]

(wherein R⁵ represents a hydrogen atom or a methyl group, Y¹ represents a hydrogen atom, a saturated hydrocarbon group or a polyalkylene glycol residue each of which may have a substituent(s), Y² represents a hydroxyl group, a saturated hydrocarbon group or a polyalkylene glycol residue each of which may have a substituent(s), and p is an integer of 1 to 100) and a derivative thereof, a polyethylene glycol and a derivative thereof, and dioctylphthalate, diheptylphthalate, dibutylphthalate, tricresylphosphate, cresyldiphenylphosphate, biphenyldiphenylphosphate, and the like.

[0046]

The formulation amount of the plasticizer is preferably 0 to 90 parts by weight, more preferably 0 to 80 parts by weight, particularly preferably 0 to 70 parts by weight based on the total amount of Component (a) and Component (b) as 100 parts by weight. If the formulation amount exceeds 90 parts by weight, sensitivity of the photosensitive resin composition constituting (A) the photosensitive resin composition layer containing a phosphor tends to be insufficient.

[0047]

To the photosensitive resin composition constituting (A) the photosensitive resin composition layer containing a phosphor of the present invention may be added a compound having a carboxyl group to prevent from increase in viscosity for a long period of term and make storage stability good.

As a compound having a carboxyl group, there may be mentioned, for example, a saturated aliphatic acid, an unsaturated aliphatic acid, an aliphatic dibasic acid, an aromatic dibasic acid, an aliphatic tribasic acid, an aromatic tribasic acid, and the like.

[0048]

Specifically, there may be mentioned, for example, formic acid, acetic acid, chloroacetic acid, dichloroacetic acid, trichloroacetic acid, propionic acid, capric acid, undecanoic acid, lauric acid, tridecanoic acid, myristic acid, pentadecanoic acid, palmitic acid, heptadecanoic acid, stearic

acid, nonadecanoic acid, arachidic acid, palmitoleic acid, oleic acid, elaidic acid, linolenic acid, linoleic acid, oxalic acid, malonic acid, methylmalonic acid, ethylmalonic acid, monomethyl malonate, monoethyl malonate, succinic acid, methylsuccinic acid, adipic acid, methyladipic acid, pimelic acid, suberic acid, azelaic acid, sebacic acid, maleic acid, itaconic acid, phthalic acid, isophthalic acid, terephthalic acid, trimellitic acid, citric acid, salicylic acid, pyruvic acid and malic acid.

Among them, from the point that an effect of suppressing thickening is high, oxalic acid, malonic acid, methylmalonic acid, ethylmalonic acid and citric acid are preferred, and oxalic acid, malonic acid and citric acid are more preferred. These compounds are used singly or in combination of two or more of them.

[0049]

The formulation amount of the compound having a carboxyl group is preferably 0 to 30 parts by weight based on 100 parts by weight of Component (a). If the formulation amount exceeds 30 parts by weight, sensitivity tends to be insufficient.

[0050]

In order to obtain good dispersion of the phosphor, it is preferred to add a dispersant to the photosensitive resin composition constituting (A) the photosensitive resin composition layer containing a phosphor in the present invention.

As the dispersant, there may be mentioned an inorganic dispersant (e.g., silica gel type, bentonite type, kaolinite type, talc type, hectorite type, montmorillonite type, saponite type and beidellite type) and an organic dispersant (e.g., aliphatic acid amide type, aliphatic acid ester type, polyethylene oxide type, a sulfate type anion surfactant, polycarboxylic acid amine salt type, polycarboxylic acid type, polyamide type, high molecular weight polyether type, acryl copolymer type and special silicone type). These dispersants are used singly or in combination of two or more of them.

[0051]

The amount of the dispersant to be used is not particularly limited, and it is preferably 0 to 100 parts by weight based on 100 parts by weight of Component (a). If the amount to be used exceeds 100 parts by weight, precision of pattern formation (property that a pattern comprising a phosphor-containing photosensitive resin composition can be obtained dimensionally precisely with a desired shape after development) tends to be lowered.

[0052]

In the photosensitive resin composition constituting (A) the photosensitive resin composition layer containing a phosphor in the present invention, it is preferred to use a binder for the purpose of preventing peeling of the phosphor from the substrate for forming a phosphor layer after calcination.

As the binder, there may be mentioned, for example, a low melting point glass, a metal alkoxide and a silane coupling agent, etc. These binders are used singly or in combination of two or more of them.

The amount of the binder to be used is not particularly limited, and it is preferably 0 to 100 parts by weight, more preferably 0 to 50 parts by weight, particularly preferably 0 to 30 parts by weight based on 100 parts by weight of Component (d). If the amount to be used exceeds 100 parts by weight, light emission efficiency tends to be lowered.

[0053]

To the photosensitive resin composition constituting (A) the photosensitive resin composition layer containing a phosphor in the present invention may be added a conventionally known dye, pigment, colorant, plasticizer, polymerization inhibitor, surface modifier, stabilizer, adhesiveness imparting agent, heat curing agent, etc. depending on necessity.

[0054]

The photosensitive element for a field emission display of the present invention comprises (A) the photosensitive resin composition layer containing a phosphor on a support

film.

Also, the photosensitive element for a field emission display of the present invention preferably comprises, on a support film, (B) a filling layer and on the filling layer, (A) the photosensitive resin composition layer containing a phosphor is further provided to improve workability, etc.

Also, the photosensitive element for a field emission display of the present invention preferably employs the above-mentioned photosensitive resin composition constituting (A) the photosensitive resin composition layer containing a phosphor of the present invention as (A) a photosensitive resin composition layer containing a phosphor in the points of workability and photosensitivity, etc.

[0055]

The photosensitive element for a field emission display of the present invention can be formed by dissolving or mixing the above-mentioned respective components constituting the above-mentioned (A) the photosensitive resin composition layer containing a phosphor in a suitable solvent which can dissolve or disperse the respective components to prepare a uniform solution or dispersion, then coating the solution or the dispersion on a support film and drying the same.

Also, the photosensitive film for a field emission display of the present invention can be obtained by dissolving or mixing the above-mentioned resin, etc. constituting (B) the filling layer mentioned below in a suitable solvent to prepare a uniform solution, coating the solution on a support film and drying the same, then, dissolving or mixing the above-mentioned respective components constituting the above-mentioned (A) the photosensitive resin composition layer containing a phosphor in a suitable solvent which can dissolve or disperse the respective components to prepare a solution or uniform dispersion, then coating the solution or the dispersion on (B) the filling layer and drying the same.

[0056]

As the support film in the present invention, there may

be mentioned those which are chemically and thermally stable and constituted by a plastic material, for example, polyethylene terephthalate, polycarbonate, polyethylene, polypropylene, etc., of these, polyethylene terephthalate and polyethylene are preferred, and polyethylene terephthalate is more preferred.

Since the support film shall be removable from (A) the photosensitive resin composition layer containing a phosphor at a later stage, it shall not be a film the surface of which is subjected to surface treatment which makes removal impossible or shall not comprise such a material.

The thickness of the support film is preferably 5 to 100 μm , more preferably 10 to 80 μm .

[0057]

As the solvent which can dissolve or disperse the above-mentioned respective components constituting (A) the photosensitive resin composition layer containing a phosphor, there may be mentioned, for example, toluene, acetone, methyl ethyl ketone, methyl isobutyl ketone, methyl cellosolve, ethyl cellosolve, γ -butyrolactone, N-methylpyrrolidone, dimethylformamide, tetramethylsulfone, diethylene glycol dimethyl ether, diethylene glycol monobutyl ether, chloroform, methylene chloride, methyl alcohol, ethyl alcohol, etc. These may be used singly or in combination of two or more.

[0058]

As the coating method, any methods conventionally known in the art may be used, and there may be mentioned, for example, the knife coating method, the roll coating method, the spray coating method, the gravure coating method, the bar coating method, and the curtain coating method, etc.

The drying temperature is preferably 60 to 130°C and the drying time is preferably 3 minutes to one hour.

[0059]

The thickness of (A) the photosensitive resin composition layer containing a phosphor of the photosensitive element for a field emission display of the present invention is not particularly limited, and the thickness is preferably made 5

to 200 μm , more preferably 8 to 120 μm , particularly preferably 10 to 80 μm . If the thickness is less than 5 μm , a phosphor pattern after calcination mentioned below becomes thin and emission efficiency tends to be lowered, while if it exceeds 200 μm , the shape of the phosphor pattern tends to be bad.

[0060]

(A) The photosensitive resin composition layer containing a phosphor of the photosensitive element for a field emission display of the present invention preferably has a viscosity at 100°C of 1 to 1×10^9 Pa·sec, more preferably 2 to 1×10^8 Pa·sec, particularly preferably 5 to 1×10^7 Pa·sec, extremely preferably 10 to 1×10^6 Pa·sec. If the viscosity at 100°C is less than 1 Pa·sec, the viscosity at room temperature becomes too low and when a photosensitive element is prepared by using the composition, (A) the photosensitive resin composition layer containing a phosphor tends to be exuded from an edge portion whereby a film forming property tends to be lowered. Also, if it exceeds 1×10^9 Pa·sec, adhesive properties of (A) the photosensitive resin composition layer containing a phosphor to the substrate to which a conductive layer tends to be lowered.

[0061]

As sensitivity of (A) the photosensitive resin composition layer containing a phosphor of the present invention, when active light is irradiated with a predetermined image and a predetermined dose of active light by using 21 grades step tablet available from Hitachi Chemical Co., Ltd., etc. in the step of irradiating active light mentioned hereinbelow with a predetermined image, and development is carried out by the step of removing unnecessary portion by development mentioned hereinbelow, the step number of the remaining step tablet of (A) the photosensitive resin composition layer containing a phosphor is preferably 1 to 21 grades, more preferably 1.5 to 18 grades, particularly preferably 2 to 15 grades.

[0062]

As resolution of (A) the photosensitive resin composition layer containing a phosphor of the present invention, when active light is irradiated with a predetermined image and a predetermined dose of active light by using a photomask for evaluating resolution available from Hitachi Chemical Co., Ltd., etc., and development is carried out by the step of removing unnecessary portion by development mentioned hereinbelow, the minimum line/space of the remaining (A) the photosensitive resin composition layer containing a phosphor is preferably 1 mm/1 mm or less, more preferably 900 μ m/900 μ m or less, particularly preferably 800 μ m/800 μ m.

[0063]

As adhesive properties of (A) the photosensitive resin composition layer containing a phosphor of the present invention, when active light is irradiated with a predetermined image and a predetermined dose of active light by using a photomask for evaluating resolution available from Hitachi Chemical Co., Ltd., etc., and development is carried out by the step of removing unnecessary portion by development mentioned hereinbelow, the minimum line/space of the remaining (A) the photosensitive resin composition layer containing a phosphor is preferably 400 μ m/400 μ m or less, more preferably 350 μ m/400 μ m or less, particularly preferably 300 μ m/400 μ m.

[0064]

On (A) the photosensitive resin composition layer containing a phosphor of the photosensitive element for a field emission display of the present invention, a removable cover film may be laminated.

As the cover film, there may be mentioned polyethylene, polypropylene, polyethylene terephthalate, polycarbonate, etc. Preferred materials are those which have an adhesive force to (A) the photosensitive resin composition layer containing a phosphor smaller than an adhesive force between the support film and (A) the photosensitive resin composition layer containing a phosphor.

The thickness of the cover film is not particularly

limited, but it is preferably 5 to 100 μm , more preferably 10 to 90 μm .

The thus prepared photosensitive element for a field emission display of the present invention can be stored by wounding in a roll state.

[0066]

As a material for constituting (B) the filling layer in the photosensitive element for a field emission display of the present invention, it is not particularly limited so long as a resin having thermoplastic properties which deforms by a stress from outside, and there may be mentioned, for example, (a) a film-forming property imparting polymer, polyethylene, polypropylene, polyvinyl chloride, polyvinyl acetate, polyvinylidene chloride, polystyrene, polyvinyltoluene, polyacrylic acid ester, polymethacrylic acid ester, a copolymer of ethylene and vinyl acetate, a copolymer of ethylene and acrylic acid ester, a copolymer of vinyl chloride and vinyl acetate, a copolymer of styrene and acrylic acid ester or methacrylic acid ester, a copolymer of vinyl toluene and acrylic acid ester or methacrylic acid ester, a polyvinyl alcohol type resin (a hydrolyzed product of a polyacrylic acid ester or polymethacrylic acid ester, a hydrolyzed product of polyvinyl acetate, a hydrolyzed product of a copolymer of ethylene and vinyl acetate, a hydrolyzed product of a copolymer of ethylene and acrylic acid ester, a hydrolyzed product of a copolymer of vinyl chloride and vinyl acetate, a hydrolyzed product of a copolymer of styrene and acrylic acid ester or methacrylic acid ester, a hydrolyzed product of a copolymer of vinyl toluene and acrylic acid ester or methacrylic acid ester, etc.), a water-soluble salt of carboxyalkyl cellulose, a water-soluble cellulose ether, a water-soluble salt of carboxyalkyl starch, polyvinylpyrrolidone, a resin having a carboxyl group obtained by copolymerizing an unsaturated carboxylic acid and an unsaturated monomer copolymerizable therewith, and the like.

[0066]

Also, to (B) the filling layer in the photosensitive element for a field emission display of the present invention, in view of restraining migration of color, workability, improvement in a film-forming property, a plasticizer may be added. As the plasticizer to be used, there may be mentioned the above-mentioned (b) a photopolymerizable unsaturated compound having an ethylenically unsaturated group at the terminal, a polyalkylene glycol derivative such as a polypropylene glycol represented by the formula (II):

[Formula 5]

(wherein R^5 represents a hydrogen atom or a methyl group, Y^1 represents a hydrogen atom, a saturated hydrocarbon group or a polyalkylene glycol residue each of which may have a substituent(s), Y^2 represents a hydroxyl group, a saturated hydrocarbon group or a polyalkylene glycol residue each of which may have a substituent(s), and p is an integer of 1 to 100) and a derivative thereof, a polyethylene glycol and a derivative thereof, and dioctylphthalate, diheptylphthalate, dibutylphthalate, tricresylphosphate, cresyldiphenylphosphate, biphenyldiphenylphosphate, and the like.

[0067]

Also, in (B) the filling layer in the photosensitive element for a field emission display of the present invention, (c) a photoinitiator which forms a free radical by irradiation of active light may be contained.

[0068]

A formulation amount of the resin having thermoplasticity to be contained in (B) the filling layer in the photosensitive element for a field emission display of the present invention is preferably 10 to 100 parts by weight, more preferably 20 to 100 parts by weight based on the total amount of the resin component and the plasticizer component as 100 parts by weight. If the formulation amount is less than 10 parts by

weight, when a film is prepared, the resin composition is exuded at an edge portion by flow or the film-forming property tends to be lowered.

[0069]

Also, the formulation amount of the plasticizer to be contained in (B) the filling layer in the photosensitive element for a field emission display of the present invention is preferably 0 to 90 parts by weight, and more preferably 0 to 80 parts by weight based on the total amount of the resin component and the plasticizer component as 100 parts by weight. If the formulation amount exceeds 90 parts by weight, when a film is prepared, it is exuded at an edge portion by flow or the film-forming property tends to be lowered.

[0070]

Moreover, a formulation amount of Component (c) the photoinitiator which forms a free radical by irradiation of active light to be contained in (B) the filling layer in the photosensitive element for a field emission display of the present invention is preferably 0 to 30 parts by weight, and more preferably 0 to 20 parts by weight based on the total amount of the resin component and the plasticizer component as 100 parts by weight. If the formulation amount exceeds 30 parts by weight, absorption of the active light at the exposure surface increases whereby photocuring at the inside tends to be insufficient.

[0071]

Also, (B) the filling layer in the photosensitive element for a field emission display of the present invention is preferably a material in which (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer can be developed by using the same developing solution in the developing step mentioned hereinbelow in the point of decreasing a number of the steps.

As a material which can be developed by the same developing solution, there may be mentioned those soluble in water or in an aqueous alkali solution.

[0072]

As a resin constituting (B) the filling layer which is soluble in water or an aqueous alkali solution, there may be mentioned, for example, a polyvinyl alcohol type resin, a hydrolyzate of polyacrylate or polymethacrylate, a hydrolyzate of polyvinyl acetate, a hydrolyzate of a copolymer of ethylene and vinyl acetate, a hydrolyzate of a copolymer of ethylene and acrylate, a hydrolyzate of a copolymer of vinyl chloride and vinyl acetate, a hydrolyzate of a copolymer of styrene and acrylate or methacrylate, a hydrolyzate of a copolymer of vinyltoluene and acrylate or methacrylate, etc., and a water-soluble salt of carboxyalkyl cellulose, water-soluble cellulose ethers, a water-soluble salt of carboxyalkyl starch, polyvinyl pyrrolidone, a resin having a carboxyl group obtained by copolymerizing an unsaturated carboxylic acid and an unsaturated monomer which is copolymerizable therewith, and the like.

[0073]

As the resin having a carboxyl group obtained by copolymerizing an unsaturated carboxylic acid and an unsaturated monomer copolymerizable with these, there may be preferably used, for example, a vinyl copolymer obtained by copolymerizing an unsaturated carboxylic acid (acrylic acid, methacrylic acid, maleic acid, fumaric acid, itaconic acid, etc.) and the above-mentioned vinyl monomer usable for (a) a film-property imparting polymer constituting (A) the photosensitive resin composition layer containing a phosphor, and the like.

The resin having a carboxyl group obtained by copolymerizing an unsaturated carboxylic acid and an unsaturated monomer copolymerizable with these preferably has a weight average molecular weight of 5,000 to 300,000, more preferably 20,000 to 150,000. If the weight average molecular weight is less than 5,000, film-forming property and flexibility tend to be lowered when a photosensitive element is prepared, while if it exceeds 300,000, developability tends to be lowered.

[0074]

Also, in order that (B) the filling layer soluble in an aqueous alkali solution can be developed by known various developing solutions, the carboxyl group content (which can be regulated by an acid value (mgKOH/g)) of the resin having a carboxyl group obtained by copolymerizing an unsaturated carboxylic acid and an unsaturated monomer copolymerizable with these can be adjusted suitably.

For example, when development is carried out by using an aqueous alkali solution of sodium carbonate, potassium carbonate or the like, the acid value is preferably set to 90 to 260. If the acid value is less than 90, development tends to be difficult, while if it exceeds 260, developing solution resistance tends to be lowered.

Also, when development is carried out by using an aqueous developing solution comprising water or an aqueous alkali solution and at least one organic solvent, the acid value is preferably made 16 to 260. If the acid value is less than 16, development tends to be difficult, while if it exceeds 260, developing solution resistance tends to be lowered.

[0075]

Among the materials as mentioned above, for example, as for polyethylene, polypropylene, Teflon, etc. may be used as (B) the filling layer by molding to a film state using the melt extrusion method, etc.

[0076]

As the solvent which can dissolve the above-mentioned resin, etc. constituting (B) the filling layer in the photo-sensitive element for a field emission display of the present invention, there may be mentioned, for example, water, toluene, acetone, methyl ethyl ketone, methyl isobutyl ketone, methyl cellosolve, ethyl cellosolve, γ -butyrolactone, N-methylpyrrolidone, dimethylformamide, tetramethylsulfone, diethylene glycol dimethyl ether, diethylene glycol monobutyl ether, chloroform, methylene chloride, methyl alcohol, ethyl alcohol, etc. These may be used singly or in combination of two or more.

As the coating method, any methods conventionally known in the art may be used, and there may be mentioned, for example, the knife coating method, the roll coating method, the spray coating method, the gravure coating method, the bar coating method, and the curtain coating method, etc.

The drying temperature is preferably 60 to 130°C and the drying time is preferably 3 minutes to one hour.

[0077]

The thickness of (B) the filling layer in the photosensitive element for a field emission display of the present invention is not particularly limited, and in view of patterning properties of three colors of phosphor layers of R, G and B on the substrate for forming the FED phosphor layer, it is preferably made 10 to 200 μm , more preferably 20 to 100 μm .

Also, (B) the filling layer in the photosensitive element for a field emission display of the present invention preferably has a viscosity at 100°C of 1 to 1×10^9 Pa·sec, more preferably 2 to 1×10^8 Pa·sec, particularly preferably 5 to 1×10^7 Pa·sec, extremely preferably 10 to 1×10^6 Pa·sec. If the viscosity at 100°C is less than 1 Pa·sec, the viscosity at room temperature becomes too low and when a film is prepared by using the composition, (B) the filling layer tends to be exuded from an edge portion by flow whereby a film forming property tends to be lowered. If it exceeds 1×10^9 Pa·sec, three colors of phosphor layers of R, G and B of (A) the photosensitive resin composition layer containing a phosphor tends to be not uniformly formed.

[0078]

After forming (B) the filling layer on the support film, by forming (A) the photosensitive resin composition layer containing a phosphor as mentioned above thereon, a photosensitive element for a field emission display of the present invention can be obtained.

Also, on (B) the filling layer of the photosensitive element for a field emission display of the present invention having (A) the photosensitive resin composition layer contain-

ing a phosphor and (B) the filling layer, a removable cover film may be laminated.

As the cover film, there may be mentioned, for example, polyethylene, polypropylene, polyethylene terephthalate, polycarbonate, etc., and preferred are those having an adhesive force between the cover film and (B) the filling layer being smaller than an adhesive force between (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer.

Also, (B) the filling layer of the present invention may be a laminated structure of the above-mentioned materials of components which can be used.

The thus prepared photosensitive element for a field emission display of the present invention having (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer in a film state can be stored by wounding in a roll state.

[0079]

Also, (B) the filling layer in the photosensitive element for a field emission display of the present invention can be supplied in the form of a film or a sheet obtained by making a uniform solution of the above-mentioned resin constituting the layer which is dissolved or mixed in a solvent capable of dissolving the resin, and coating on a support film and drying.

As the support film, there may be mentioned a material which is chemically and thermally stable and constituted by a flexible substance, for example, polyethylene terephthalate, polycarbonate, polyethylene and polypropylene. Among them, polyethylene terephthalate and polyethylene are preferred, and polyethylene terephthalate is more preferred.

The thickness of the support film is preferably 5 to 100 μm , more preferably 10 to 30 μm .

[0080]

Also, on (B) the filler layer, a removable cover film can be further laminated.

As the cover film, there may be mentioned polyethylene, polypropylene, polyethylene terephthalate, polycarbonate, etc., and preferred are those having an adhesive force between the cover film and (B) the filling layer being smaller than an adhesive force between the support film and (B) the filling layer.

(B) The filling layer thus formed in a film state can be stored by wounding in a roll state.

[0081]

Also, (B) the filling layer in the present invention may be a laminated structure of the above-mentioned components which can be used.

Incidentally, (B) the filling layer in the present invention must be finally removed from (A) the photosensitive resin composition layer containing a phosphor. Thus, it is preferred to optionally and previously select a material which is capable of removing from (A) the photosensitive resin composition layer containing a phosphor.

[0082]

In a film having (A) the photosensitive resin composition layer containing a phosphor and a film having (B) the filling layer in the present invention, in view of workability, the film having (A) the photosensitive resin composition layer containing a phosphor preferably comprises a support film, (A) the photosensitive resin composition layer containing a phosphor and a cover film, and the film having (B) the filling layer preferably comprises a support film, (B) the filling layer and a cover film.

Also, in the step of removing (B) the filling layer mentioned hereinbelow, in order to improve peeling property of (B) the filling layer, a film for easily separating the layer (B) and the layer (A), which has a small adhesive force with (A) the photosensitive resin composition layer containing a phosphor and the cover film than that with (B) the filling layer may be provided between (B) the filling layer and the cover film.

[0083]

In the following, one example of a process for preparing a phosphor pattern for a field emission display of the present invention will be explained by referring to the respective steps of Fig. 3 when a substrate for preparing a phosphor layer to be used as a transmittance type FED front panel to which a conductive layer and a black matrix are formed. Incidentally, Fig. 3 is a schematic view showing respective steps of one example of the process for preparing a phosphor pattern for a field emission display of the present invention.

[0084]

[(I) Step of forming (A) a photosensitive resin composition layer containing a phosphor on a substrate onto which a conductive layer is formed]

In the step of (I), (A) the photosensitive resin composition layer containing a phosphor is formed on the substrate to which the conductive layer and the black matrix are formed.

As a method for preparing (A) the photosensitive resin composition layer containing a phosphor, there may be mentioned, for example, a method wherein a solution of the photosensitive resin composition constituting (A) the photosensitive resin composition layer containing a phosphor is coated by using a conventionally known method to form a photosensitive resin composition layer, a method wherein the photosensitive elements for a field emission display of the present invention as mentioned above are used and they are laminated to form a photosensitive resin composition layer, and the like.

Incidentally, in view of workability, environmental safety, and film-forming property of the photosensitive resin layer to a large-sized surface substrate, it is preferred to use the method wherein the photosensitive elements for a field emission display of the present invention are used and they are laminated to form a photosensitive resin composition layer.

[0085]

As the coating method in the method wherein a solution of the photosensitive resin composition is coated by using a conventionally known method to form a photosensitive resin composition layer, there may be mentioned, for example, a roll coating method, a spray coating method, an electrodeposition coating method, a curtain coating method, or the like. Of these, in the case of a substrate with a large-sized surface, a curtain coating method is preferably used since a photosensitive resin composition layer can be uniformly formed with simply and easily.

[0086]

As a process for forming (A) the photosensitive resin composition layer containing a phosphor by using the photosensitive elements for a field emission display of the present invention, there may be mentioned, for example,

- ① (Ia) a process of placing a photosensitive element having (A) a photosensitive resin composition layer containing a phosphor formed on a support film on the substrate to which a conductive layer is formed so as to contact (A) the photosensitive resin composition layer containing a phosphor with the substrate to which a conductive layer is formed and applying a pressure to (A) the photosensitive resin composition layer containing a phosphor to laminate (A) the photosensitive resin composition layer containing a phosphor on the substrate to which a conductive layer is formed,
- ② (Ib) a process which comprises the steps of placing, on a substrate to which a conductive layer is formed, (B) a filling layer on (A) a photosensitive resin composition layer containing a phosphor and in such a state, applying a pressure to (B) the filling layer to laminate (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer on the substrate to which a conductive layer is formed, and (Ic) a step of removing (B) the filling layer,
- ③ (Ib') a process which comprises the steps of placing a photosensitive element having (B) a filling layer on a support film and (A) a photosensitive resin composition layer contain-

ing a phosphor thereon on the substrate to which a conductive layer is formed so as to contact (A) the photosensitive resin composition layer containing a phosphor with the substrate to which a conductive layer is formed and applying a pressure to (B) the filling layer to laminate (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer on the substrate to which a conductive layer is formed, and (Ic) a step of removing (B) the filling layer.

[0087]

In the following, processes for laminating (A) the photosensitive resin composition layer containing a phosphor by using the processes ② and ③ will be explained in more detail.

A substrate for forming a FED phosphor layer to which a conductive layer 2 and a black matrix are formed is shown in Fig. 3(I), and a state of forming (A) a photosensitive resin composition layer containing a phosphor and (B) a filling layer on the substrate for forming a FED phosphor layer in which pressure is applied to (B) the filling layer in the state of providing (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer on the substrate is shown in Fig. 3(II).

In Fig. 3(I) and Fig. 3(II), the reference numeral 3 is a black matrix, 4 is (A) a photosensitive resin composition layer containing a phosphor, 5 is (B) a filling layer and 6 is a pressing roller.

[0088]

In Fig. 3(II), as a method for forming (A) the photosensitive resin composition layer 4 containing a phosphor on the substrate 1 for forming a FED phosphor layer, there may be mentioned, for example, a method of laminating with the use of the above-mentioned photosensitive element having the support film, (B) the filling layer and (A) the photosensitive resin composition layer containing a phosphor, and the like.

[0089]

When lamination is carried out by using the photosensitive element and a cover film is present in the photosensitive

element, after removing the cover film, (B) the filling layer 5 is provided at the upper side of (A) the photosensitive resin composition layer 4 containing a phosphor so as to contact (A) the photosensitive resin composition layer 4 containing a phosphor with the surface of the substrate 1 for forming a FED phosphor layer to which the conductive layer 2 is formed, then (B) the filling layer 5 is pressed to laminate (A) the photosensitive resin composition layer 4 containing a phosphor and (B) the filling layer 5 to the substrate 1 for forming a FED phosphor layer.

[0090]

In Fig. 3(II), as the method of press by providing (B) the filling layer 5 at the upper portion of (A) the photosensitive resin composition layer 4 containing a phosphor, there may be mentioned, for example, the method in which (B) the filling layer 5 (when a cover film is present, after removing the cover film) is provided at the upper portion of (A) the photosensitive resin composition layer 4 containing a phosphor and then pressed the same with a pressing roller 6, etc., and the like.

Also, in order to form three colors of phosphor layers of R, G and B of (A) the photosensitive resin composition layer 4 containing a phosphor more uniformly, when a support film is present on (B) the filling layer 5, press may be carried out by a pressing roller 6, etc. while removing the support film depending on necessity.

[0091]

The bonding pressure at this time is preferably 2.4×10^2 to 2.4×10^5 N/m, more preferably 4.8×10^2 to 1.2×10^5 N/m, particularly preferably 9.6×10^2 to 2.4×10^4 N/m in a linear pressure. If the linear pressure is less than 2.4×10^2 N/m, a property of uniformly forming three colors of phosphor layers of R, G and B of (A) the photosensitive resin composition layer 4 containing a phosphor tends to be lowered, while if it exceeds 2.4×10^5 N/m, the substrate 1 for forming a FED phosphor layer tends to be broken.

[0092]

Here, as the method for making the linear pressure 5×10^3 N/m, there may be mentioned, for example, a method in which the linear pressure is made 5×10^3 N/m by making a cylinder pressure (normal pressure of 1 atom is 0) of a laminating machine 2 kgf/cm² using a laminating machine having a cylinder diameter of 40 mm ϕ and a substrate with a size of 3 mm in thickness, 10 cm in width and 10 cm in length (square), a method in which the linear pressure is made 5×10^3 N/m by making a cylinder pressure (normal pressure of 1 atom is 0) of a laminating machine 4 kgf/cm² using a laminating machine having a cylinder diameter of 40 mm ϕ and a substrate with a size of 3 mm in thickness, 20 cm in width and 20 cm in length (square), and the like.

[0093]

Also, in order to further improve formation of three colors of phosphor layers of R, G and B of (A) the photosensitive resin composition layer 4 containing a phosphor more uniformly, lamination may be carried out by pressing (B) the filling layer 5 while heating by a heating roller, etc., to the surface of the substrate 1 for forming a FED phosphor layer, on which the conductive layer 2 is formed.

The heating temperature when heating is carried out is preferably 10 to 140°C, more preferably 20 to 135°C, particularly preferably 30 to 130°C. If the heating temperature is less than 10°C, a property of uniformly forming three colors of phosphor layers of R, G and B of (A) the photosensitive resin composition layer 4 containing a phosphor tends to be lowered, while if it exceeds 140°C, (A) the photosensitive resin composition layer 4 containing a phosphor tends to be heat-cured.

[0094]

When (B) the filling layer 5 is heated as mentioned above, it is not necessary to carry out preheating of the substrate 1 for forming a FED phosphor layer, but in order to further improve formation of three colors of phosphor layers

of R, G and B of (A) the photosensitive resin composition layer 4 containing a phosphor more uniformly, it is preferred to carry out a preheat treatment of the substrate 1 for forming a FED phosphor layer.

The preheating temperature at this time is preferably 30 to 140°C, and the preheating time is preferably 0.5 to 20 minutes.

Also, in order to further improve a property of uniformly forming three colors of phosphor layers of R, G and B of (A) the photosensitive resin composition layer 4 containing a phosphor, a material in which the surface of a heat-pressure roller is made of a material enriched in flexibility such as rubber, plastics, etc. may be used.

Incidentally, the thickness of the layer of the material enriched in flexibility is preferably made 200 to 400 μm .

[0095]

Further, for the same purpose as mentioned above, the above-mentioned pressure and heat-pressure may be carried out under a reduced pressure of 5×10^4 Pa or less.

Also, after completion of the lamination, heating may be carried out within the range of 30 to 150°C for 1 to 120 minutes. At this time, when a support film is present on (B) the filling layer 5, the support film may be removed depending on necessity.

As described above, (A) the photosensitive resin composition layer 4 containing a phosphor can be formed uniformly on the substrate 1 for forming a FED phosphor layer.

[0096]

Also, in Fig. 3(II), (A) the photosensitive resin composition layer 4 containing a phosphor and (B) the filling layer 5 may be separately laminated by each pressing under heating.

As the heat-pressure conditions when the two layers are separately pressed under heating, the conditions where the above-mentioned conditions for heat pressing the two layers simultaneously can be used.

The state in which (A) the photosensitive resin compo-

sition layer 4 containing a phosphor and (B) the filling layer 5 are laminated as mentioned above is shown in Fig. 3(III).

[0097]

Next, the state where (B) the filling layer 5 is removed from the state of Fig. 3(III) is shown in Fig. 3(IV).

When removing (B) the filling layer 5, in order to easily remove (B) the filling layer 5, the substrate 1 for forming a FED phosphor layer may be cooled (generally in the range of -50 to 50°C) at the state of Fig. 3(III).

As the method for removing (B) the filling layer 5, there may be mentioned, for example, a method of physically peeling off (B) the filling layer 5 by bonding an adhesive tape on (B) the filling layer 5 or using a tool with a hook shape, etc., and the like.

In order to improve workability, a method of peeling off (B) the filling layer 5 by utilizing a power of static electricity, suction, etc.

Also, immediately after peeling (B) the filling layer 5, (B) the filling layer 5 can be wound by using a wind-up roller, etc.

[0098]

[(II) Step of irradiating active light with a predetermined image to (A) the photosensitive resin composition layer containing a phosphor]

The state of irradiating active light with a predetermined image to (A) the photosensitive resin composition layer 4 containing a phosphor is shown in Fig. 3(V). In Fig. 3(V), the reference numeral 7 is a photomask and 8 is active light.

In Fig. 3(V), as the method of irradiating active light 8 with a predetermined image, there may be mentioned a method in which active light 8 is irradiated with a predetermined image to the upper portion of (A) the photosensitive resin composition layer 4 containing a phosphor in the state of Fig. 3(IV) through a photomask 7 such as a negative film, a positive film, etc., and the like.

At this time, on (A) the photosensitive resin composition

layer 4 containing a phosphor, the above-mentioned support film is newly covered and active light 8 may be irradiated with a predetermined image.

Also, when (B) the filling layer 5 comprises a material which transmit the active light 8, the present step is carried out in the state that (B) the filling layer 5 is provided, and then, the above-mentioned step of removing (B) the filling layer may be carried out.

[0099]

As the active light 8, known active light source may be used, and there may be mentioned, for example, light generated from carbon arc, mercury vapor arc, xenon arc, and others.

The sensitivity of the photoinitiator is generally the maximum at the ultraviolet ray region so that the active light source at that case shall be those which irradiate the ultraviolet ray effectively. Also, when the photoinitiator is sensitive to visible light such as 9,10-phenanthrenequinone, etc., a visible light is used as the active light 8. As the light source, in addition to the above-mentioned light sources, flood bulb for photography, solar lamp, etc., may be used.

[0100]

Also, as the active light 8 in the present invention, there may be mentioned parallel light, scattered light, etc., and either of the parallel light or the scattered light may be used, the both may be used in one step, or else, the both may be used separately with two steps. Incidentally, when both of them are used separately with two steps, either one of which may be used firstly.

Also, a dose of the active light 8 in the present invention is not particularly limited, but in view of photocurability, it is preferably made 5 to 10000 mJ/cm², more preferably 7 to 5000 mJ/cm², particularly preferably 10 to 1000 mJ/cm².

[0101]

[(III) Step of forming pattern by selectively removing (A) the

photosensitive resin composition layer containing a phosphor to which active light is irradiated with a predetermined image by development]

The state in which unnecessary portion is removed by development is shown in Fig. 3(VI). Incidentally, in Fig. 3(VI), the reference numeral 4' is a photosensitive resin layer containing a phosphor after photocuring.

In Fig. 3(VI), as the method of development, there may be mentioned, for example, a method in which, after irradiating the active light 8 with a predetermined image, when the support film and (B) the filling layer 5 are present on (A) the photosensitive resin composition layer 4 containing a phosphor, these layers are removed, and then, development is carried out by the conventionally known method such as spraying, dipping under rocking, brushing, scrapping, etc. by using a known developing solution such as an aqueous alkali solution, an aqueous developing solution, an organic solvent, etc., to remove the unnecessary portion.

[0102]

Also, as the method of removing the unnecessary portion of (A) the photosensitive resin composition layer 4 containing a phosphor, dry development in which only the unnecessary portion having adhesiveness of (A) the photosensitive resin composition layer 4 containing a phosphor is peeled off by utilizing the difference between the exposed portion and the unexposed portion may be carried out.

[0103]

As a base for the aqueous alkali solution, there may be mentioned alkali hydroxides (hydroxide of lithium, sodium or potassium, etc.), alkali carbonates (carbonate or bicarbonate of lithium, sodium or potassium, etc.), alkali metal phosphoric acid salts (potassium phosphate, sodium phosphate, etc.), alkali metal pyrophosphoric acid salts (sodium pyrophosphate, potassium pyrophosphate, etc.), tetramethyl ammonium hydroxide, triethanolamine, etc., and of these, sodium carbonate, tetramethyl ammonium hydroxide, etc. may be

mentioned as preferred ones.

A pH of the aqueous alkali solution to be used for development is preferably 9 to 11, and the temperature thereof can be adjusted in comply with the developability of (A) the photosensitive resin composition layer 4 containing a phosphor.

Also, to the aqueous alkali solution, a surfactant, an anti-foaming agent, a small amount of an organic solvent for promoting development may be added.

[0104]

As the aqueous developing solution, there may be mentioned a developing solution comprising water or the aqueous alkali solution and at least one of an organic solvent.

Here, as a base of the aqueous alkali solution, in addition to the above-mentioned substances, there may be mentioned, for example, borax, sodium metasilicate, ethanolamine, ethylenediamine, diethylenetriamine, 2-amino-2-hydroxymethyl-1,3-propanediol, 1,3-diaminopropanol-2-morpholine, tetramethyl ammonium hydroxide, etc.

A pH of the aqueous developing solution is preferably 8 to 12, more preferably 9 to 10.

[0105]

In the aqueous developing solution comprising water and at least one kind of an organic solvent (when the organic solvent is not dissolved in water, it is an emulsion solution), as the organic solvent, there may be mentioned, for example, acetone alcohol, acetone, ethyl acetate, alkoxyethanol having an alkoxy group with 1 to 4 carbon atoms, ethyl alcohol, isopropyl alcohol, butyl alcohol, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, triethylene glycol monobutyl ether, dipropylene glycol monomethyl ether, dipropylene glycol monopropyl ether, 3-methyl-3-methoxybutyl acetate, 1,1,1-trichloroethane, N-methylpyrrolidone, N,N-dimethylformamide, cyclohexanone, methyl isobutyl ketone, γ -butyrolactone, etc. These may be used singly or in combination of two or more.

The concentration of the organic solvent is generally within the range of 2 to 90% by weight, and the temperature can be adjusted depending on the developability thereof.

Also, to the aqueous developing solution, a small amount of a surfactant, an anti-foaming agent, etc. may be added.

[0106]

As the organic solvent developing solution which is used alone, there may be mentioned, for example, 1,1,1-trichloroethane, N-methylpyrrolidone, N,N-dimethylformamide, cyclohexanone, methyl isobutyl ketone, γ -butyrolactone, etc. To these organic solvents, water may be added within the range of 1 to 20% by weight in order to prevent from flaming.

Also, in the conventionally known developing solution such as water, aqueous alkali solution, aqueous developing solution (those which comprise water and at least one kind of an organic solvent or the aqueous alkali solution and at least one kind of an organic solvent), organic solvent, etc., it is preferred to not contain a metal ion other than the alkali metal ion nor a halogen ion in the point of preventing from deterioration of the phosphor at development.

[0107]

After development, for the purpose of preventing deterioration of the phosphor, the base of the alkaline aqueous solution remaining on (A) the photosensitive resin composition layer 4' containing a phosphor after photocuring may be subjected to acid treatment (neutralization treatment) by using an organic acid, an inorganic acid or an acid aqueous solution thereof according to a known method such as spraying, dipping by rocking, blushing and scrapping.

As the acid, there may be mentioned, for example, an organic acid such as a saturated aliphatic acid, an unsaturated aliphatic acid, an aliphatic dibasic acid, an aromatic dibasic acid, an aliphatic tribasic acid and an aromatic tribasic acid, and an inorganic acid.

[0108]

As a specific organic acid, there may be mentioned, for

example, formic acid, acetic acid, chloroacetic acid, dichloroacetic acid, trichloroacetic acid, propionic acid, capric acid, undecanoic acid, lauric acid, tridecanoic acid, myristic acid, pentadecanoic acid, palmitic acid, heptadecanoic acid, stearic acid, nonadecanoic acid, arachidic acid, palmitoleic acid, oleic acid, elaidic acid, linolenic acid, linoleic acid, oxalic acid, malonic acid, methylmalonic acid, ethylmalonic acid, monomethyl malonate, monoethyl malonate, succinic acid, methylsuccinic acid, adipic acid, methyladipic acid, pimelic acid, suberic acid, azelaic acid, sebacic acid, maleic acid, itaconic acid, phthalic acid, isophthalic acid, terephthalic acid, trimellitic acid, citric acid, salicylic acid, pyruvic acid and malic acid.

Also, as a specific inorganic acid, there may be mentioned, for example, sulfuric acid, hydrochloric acid and nitric acid.

Among them, from the point of a high neutralization effect, formic acid, oxalic acid, malonic acid and citric acid which have a dissociation index pK_a value in an aqueous solution of 4 or less are mentioned to be preferred materials.

[0109]

The pH of the acid aqueous solution to be used for acid treatment is preferably 2 to 6, and the pH and temperature of the acid aqueous solution can be adjusted depending on acid resistances (durability that deterioration is not caused by acid) of (A) the photosensitive resin composition layer 4' containing a phosphor after photocuring and the substrate 1 for forming the FED phosphor layer.

Further, after acid treatment (neutralization treatment), a step of washing with water may be carried out.

[0110]

Also, after the development, in order to improve adhesiveness and chemical resistance, etc. of the photoresist containing a phosphor on the surface of the substrate for forming a phosphor layer, irradiation by ultraviolet ray due to a high pressure mercury lamp, etc., and heating may be

carried out.

A dose of irradiating the ultraviolet ray at this time is generally 0.2 to 10 J/cm², and heating may be also carried out at the time of the irradiation.

Also, the temperature at the time of heating is preferably 60 to 180°C, more preferably 100 to 180°C. The heating time is preferably 15 to 90 minutes.

Irradiation of the ultraviolet ray and heating may be carried out separately and either of which may be carried out firstly.

[0111]

[(IV) Step of forming phosphor pattern by removing unnecessary portion from the above-mentioned phosphor pattern by calcination]

The state of forming phosphor pattern after removing unnecessary portion by calcination is shown in Fig. 3(VII). Incidentally, in Fig. 3(VII), the reference numeral 9 is a phosphor pattern.

In Fig. 3(VII), the calcination method is not particularly limited, and by using the conventionally known calcination method, unnecessary portions other than the phosphor and the binder are removed to form a phosphor pattern.

[0112]

The calcination temperature at this time is preferably 350 to 800°C, more preferably 400 to 600°C. Also, the calcination time is preferably 3 to 120 minutes, more preferably 5 to 90 minutes.

The temperature-raising rate at this time is preferably 0.5 to 50°C/min, more preferably 1 to 45°C/min. Also, during 350 to 450°C before reaching to the maximum calcination temperature, a step of retaining the temperature may be provided, and the retaining time thereof is preferably 5 to 100 minutes.

Incidentally, the calcination may be carried out under air atmosphere, under nitrogen atmosphere, or under air atmosphere and nitrogen atmosphere in combination. Also, during the temperature-raising procedure, air atmosphere and

nitrogen atmosphere may be optionally used alternately.

[0113]

In the process for preparing the phosphor pattern for a field emission display of the present invention, in the point of reducing the steps or the like, it is preferred that the above-mentioned respective steps (I) to (III) are repeated for each color to form a multi-colored pattern comprising the photosensitive resin composition layers containing phosphors which form colors of red, green and blue, and then, the step (IV) is performed to form a multi-colored phosphor pattern.

In the present invention, (A) the photosensitive resin composition layer 4 containing a phosphor which independently contains respective phosphors which form colors of red, blue and green can be formed in any order with regard to the respective colors of red, blue and green.

[0114]

In Fig. 4, the state in which a multi-colored pattern containing the photosensitive resin composition layer containing a phosphor which forms colors of red, green and blue is formed by repeating the respective steps of (I) to (III) for each color is shown. In Fig. 4, the reference numeral 4'a is a first color pattern, 4'b is a second color pattern, and 4'c is a third color pattern.

In Fig. 6, the state in which the step (IV) of the present invention is performed to form a multi-colored phosphor pattern is shown. In Fig. 6, the reference numeral 9a is a first phosphor pattern, 9b is a second phosphor pattern, and 9c is a third phosphor pattern.

[0115]

Also, the process for preparing the phosphor pattern for a field emission display of the present invention is preferably carried out by repeating the respective steps (I) to (IV) as mentioned above for each color to form a multi-colored phosphor pattern in view of suppression of decrease in film thickness of (A) the photosensitive resin composition layer 5 containing a phosphor to form a multi-colored phosphor pattern

which colors to red, green and blue.

[0116]

The phosphor pattern for a field emission display of the present invention can be formed by the producing process as mentioned above, and by the phosphor pattern for a field emission display panel, a field emission display having high precision and excellent in brightness can be obtained.

[0117]

The field emission display of the present invention comprises the above-mentioned phosphor pattern for a field emission display of the present invention on the substrate for forming a FED phosphor layer.

In the following, the field emission display of the present invention is explained by referring to Fig. 6 and Fig. 7. Incidentally, Fig. 6 is a schematic view showing a sectional view of one example of a transmission type FED, and Fig. 7 is a schematic view showing a sectional view of one example of a reflection type FED.

In Fig. 6 and Fig. 7, the reference numeral 10 is an emitter cold cathode, 11 is a glass substrate, 12 is a cathode, 13 is a resistance film, 14 is a back surface substrate, and 15 is a target sheet.

[0118]

The process for producing the phosphor pattern for a field emission display panel, the photosensitive element for a field emission display and the phosphor pattern for a field emission display of the present invention can be also applied to the process for producing the phosphor pattern of a spontaneous emission display such as an electro-luminescence display (ELD), etc.

[0119]

[Examples]

In the following, the present invention is explained by referring to Examples.

Preparation example 1

[(a) Preparation of a polymer solution imparting film

property]

In a flask equipped with a stirrer, a reflux condenser, an inert gas inlet tube and a thermometer was charged ① shown in Table 1, and the temperature of the solvent was raised to 80°C under nitrogen atmosphere, and while maintaining the reaction temperature to 80°C±2°C, a mixed solution ② shown in Table 1 was uniformly added dropwise over 4 hours.

After dropwise addition of ②, stirring was continued at 80°C±2°C for 6 hours to obtain (a) a solution having a film property-imparting polymer (solid content: 45.5 % by weight) having a weight average molecular weight of 80,000 and an acid value of 130 mgKOH/g.

[0120]

[Table 1]

Table 1

Material		Formulation amount
①	Ethylene glycol mono-methyl ether	70 parts by weight
	Toluene	50 parts by weight
②	Methacrylic acid	20 parts by weight
	Methyl methacrylate	55 parts by weight
	Ethyl acrylate	15 parts by weight
	n-Butyl methacrylate	10 parts by weight
	2,2'-Azobis(isobutyronitrile)	0.5 parts by weight

[0121]

Preparation example 2

[Preparation of Solution (A-1) for (A) photosensitive resin composition layer containing phosphor]

The materials shown in Table 2 were mixed for 15 minutes by using a stirrer to prepare Solution (A-1) for (A) a photosensitive resin composition layer containing a red color forming phosphor.

[0122]

[Table 2]

Table 2

Material	Formulated amount
(a) Solution having film property imparting polymer obtained in Preparation example 1	132 parts by weight (solid content: 60 parts by weight)
Polypropylene glycol dimethacrylate (average number of propylene oxide: 12)	40 parts by weight
2-Benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butanone-1	1 parts by weight
Y ₂ O ₂ S:Eu	140 parts by weight
Methyl ethyl ketone	30 parts by weight

[0123]

Preparation example 3

[Preparation of Solution (A-2) for (A) photosensitive resin composition containing phosphor]

The materials shown in Table 3 were mixed for 15 minutes by using a stirrer to prepare Solution (A-2) for (A) a photosensitive resin composition layer containing a blue color forming phosphor.

[0124]

[Table 3]

Table 3

Material	Formulated amount
(a) Solution having film property imparting polymer obtained in Preparation example 1	132 parts by weight (solid content: 60 parts by weight)
Polypropylene glycol dimethacrylate (average number of propylene oxide: 12)	40 parts by weight
2-Benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butanone-1	2 parts by weight
ZnSi:Ag	110 parts by weight
Malonic acid	0.4 part by weight
Methyl ethyl ketone	30 parts by weight

[0125]

Preparation example 4

[Preparation of Solution (A-3) for (A) photosensitive resin composition containing phosphor]

The materials shown in Table 4 were mixed for 15 minutes

by using a stirrer to prepare Solution (A-3) for (A) a photosensitive resin composition layer containing a green color forming phosphor.

[0126]

[Table 4]

Table 4

Material	Formulated amount
(a) Solution having film property imparting polymer obtained in Preparation example 1	132 parts by weight (solid content: 60 parts by weight)
Polypropylene glycol dimethacrylate (average number of propylene oxide: 12)	40 parts by weight
2-Benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butanone-1	2 parts by weight
ZnS:Cu,Au,Al	120 parts by weight
Malonic acid	0.4 part by weight
Methyl ethyl ketone	30 parts by weight

[0127]

Example 1

[Preparation of photosensitive element (i)]

Solution (A-1) for (A) a photosensitive resin composition layer containing a red color forming phosphor obtained in Preparation example 2 was uniformly coated on the surface of a polyethylene terephthalate film with a thickness of 50 μm , and dried with a hot air convection type drier at 110°C for 10 minutes to remove the solvent whereby (A) the photosensitive resin composition layer containing a phosphor was formed. The thickness of the resulting (A) photosensitive resin composition layer containing a phosphor was 15 μm .

Then, on (A) the photosensitive resin composition layer containing a phosphor, a polyethylene film with a thickness of 25 μm was further laminated as a cover film to prepare a photosensitive element (i).

[0128]

Edge fusion property of the resulting photosensitive element (i) was evaluated by the following method and the results are shown in Table 5.

[Edge fusion property]

The photosensitive element (i) with a length of 90 m wound-up in a roll state was stored at the temperature of 23°C and the humidity of 60 % Rh, and the exuded state of the photosensitive layer from the side surface of the roll was evaluated with naked eyes for 6 months. Evaluation standard is as follows.

○: Edge fusion property is good (the photosensitive layer was not exuded after 6 months)

×: Edge fusion property is bad (the photosensitive layer was exuded after 6 months)

[0129]

Example 2

[Preparation of photosensitive element (ii)]

In the same manner as in Example 1 except for changing Solution (A-1) for (A) a photosensitive resin composition layer containing a red color forming phosphor obtained in Preparation example 2 used in Example 1 to Solution (A-2) for (A) a photosensitive resin composition layer containing a blue color forming phosphor obtained in Preparation example 3, a photosensitive element (ii) was prepared. The thickness of the resulting (A) photosensitive resin composition layer containing a phosphor of the photosensitive element (ii) was 15 μm .

Edge fusion property of the resulting photosensitive element (ii) was evaluated in the same manner as in Example 1 and the results are shown in Table 5.

[0130]

Example 3

[Preparation of photosensitive element (iii)]

In the same manner as in Example 1 except for changing Solution (A-1) for (A) a photosensitive resin composition layer containing a red color forming phosphor obtained in Preparation example 2 used in Example 1 to Solution (A-3) for (A) a photosensitive resin composition layer containing a

green color forming phosphor obtained in Preparation example 4, a photosensitive element (iii) was prepared. The thickness of the resulting (A) photosensitive resin composition layer containing a phosphor of the photosensitive element (iii) was 15 μm .

Edge fusion property of the resulting photosensitive element (iii) was evaluated in the same manner as in Example 1 and the results are shown in Table 5.

[0131]

[Table 5]

Table 5

	Photosensitive element	Solution for forming (A) photosensitive resin composition layer containing phosphor	Edge fusion property
Example 1	(i)	(A-1)	○
Example 2	(ii)	(A-2)	○
Example 3	(iii)	(A-3)	○

From the results shown in Table 5, edge fusion properties of the photosensitive elements obtained in Examples 1 to 3 were all good.

[0132]

Preparation example 5

[Preparation of Film (B-1) having (B) filling layer]

A resin solution comprising a material shown in Table 6 was uniformly coated on a polyethylene terephthalate film having a thickness of 20 μm , and dried with a hot air convection type drier at 80 to 110°C for 10 minutes to remove distilled water whereby (B) the filling layer was formed. The thickness of the resulting (B) filling layer after drying was 40 μm .

Then, on (B) the filling layer, a polyethylene terephthalate film having a thickness of 25 μm was laminated to prepare a film (B-1) having (B) the filling layer which comprises the support film, (B) the filling layer and the cover film.

[0133]

[Table 6]

Table 6

Materials	Formulated amount
Polyvinyl alcohol (produced by Kuraray, PVA205, hydrolyzed ratio=80 %)	17.3 parts by weight
Distilled water	28 parts by weight

[0134]

Preparation example 5

[Preparation of Film (B-2) having (B) filling layer]

A resin solution comprising a material shown in Table 7 was uniformly coated on a polyethylene terephthalate film having a thickness of 20 μm , and dried with a hot air convection type drier at 80 to 110°C for 10 minutes to remove the solvent whereby (B) the filling layer was formed. The thickness of the resulting (B) filling layer after drying was 30 μm .

Then, on (B) the filling layer, a polyethylene terephthalate film having a thickness of 25 μm was laminated to prepare a film (B-2) having (B) the filling layer which comprises the support film, (B) the filling layer and the cover film.

[0135]

[Table 7]

Table 7

Materials	Formulated amount
Ethylene/ethyl acrylate copolymer (65/35 (weight ratio)) (Everflex EEA709, produced by Mitsui Du'Pont K.K.)	30 parts by weight
Toluene	70 parts by weight

[0136]

Example 4

[Preparation of photosensitive element (iv)]

While peeling off each of polyethylene films of the photosensitive element (I) having (A) the photosensitive resin

composition layer containing a phosphor obtained in Example 1 and of the film (B-2) having (B) the filling layer obtained in Preparation example 6, these materials were laminated by a lamination temperature of 20°C, a lamination rate of 0.5 m/min and a bonding pressure (cylinder pressure) of 5×10^4 Pa (since a film with the width of 10 cm was used, the linear pressure at this time was 1.2×10^3 N/m) to prepare a photosensitive element (iv) having (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer.

[0137]

Example 5

[Preparation of photosensitive element (v)]

In the same manner as in Example 4 except for changing the photosensitive element (i) having (A) the photosensitive resin composition layer containing a phosphor obtained in Example 1 used in Example 4 to the photosensitive element (ii) having (A) the photosensitive resin composition layer containing a phosphor obtained in Example 2, a photosensitive element (v) having (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer was prepared.

[0138]

Example 6

[Preparation of photosensitive element (vi)]

In the same manner as in Example 4 except for changing the photosensitive element (i) having (A) the photosensitive resin composition layer containing a phosphor obtained in Example 1 used in Example 4 to the photosensitive element (iii) having (A) the photosensitive resin composition layer containing a phosphor obtained in Example 3, a photosensitive element (vi) having (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer was prepared.

[0139]

Example 7

[Preparation of photosensitive element (vii)]

In Example 6, except that the film (B-2) having (B) the

filling layer obtained in Preparation example 6 was replaced with the film (B-1) having (B) the filling layer obtained in Preparation example 5, a photosensitive element (vii) having (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer was prepared in the same manner as in Example 4.

[0140]

Preparation example 7

[Preparation of substrate ① to which (A) the photosensitive resin composition layer containing phosphor is formed]

While peeling off the polyethylene terephthalate film of the photosensitive element (iv) obtained in Example 4 at the surface of contacting with (A) the photosensitive resin composition layer containing a phosphor, it was laminated to a conductive layer side of a FED phosphor layer formed substrate to which the conductive layer and a black matrix had been formed with a lamination temperature of 120°C, a lamination rate of 0.5 m/min and a bonding pressure (cylinder pressure) of 4×10^5 Pa (since a substrate with the width of 10 cm was used, the linear pressure at this time was 9.8×10^3 N/m) to prepare a substrate ① to which (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer were laminated.

The resulting substrate (1) was cut and the cutting surface was observed by electron microscope. When the film forming property of (A) the photosensitive resin composition layer containing a phosphor was confirmed, it can be understood that a uniform and good (A) the photosensitive resin composition layer containing a phosphor had been formed.

[0141]

Preparation example 8

[Preparation of substrate ② to which (A) the photosensitive resin composition layer containing phosphor is formed]

In Preparation example 7, except that the photosensitive element (iv) obtained in Example 4 was replaced with the photosensitive element (v) obtained in Example 5, a substrate

② to which (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer were laminated was prepared in the same manner as in Preparation example 7.

The resulting substrate ② was cut and the cutting surface was observed by electron microscope. When the film forming property of (A) the photosensitive resin composition layer containing a phosphor was confirmed, it can be understood that a uniform and good (A) the photosensitive resin composition layer containing a phosphor had been formed.

[0142]

Preparation example 9

[Preparation of substrate ③ to which (A) the photosensitive resin composition layer containing a phosphor is formed]

In Preparation example 7, except that the photosensitive element (iv) obtained in Example 4 was changed to the photosensitive element (vi) obtained in Example 6, a substrate ③ to which (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer were laminated was prepared in the same manner as in Preparation example 7.

The resulting substrate ③ was cut and the cutting surface was observed by electron microscope. When the film forming property of (A) the photosensitive resin composition layer containing a phosphor was confirmed, it can be understood that a uniform and good (A) the photosensitive resin composition layer containing a phosphor had been formed.

[0143]

Preparation example 10

[Preparation of substrate ④ to which (A) the photosensitive resin composition layer containing a phosphor is formed]

In Preparation example 7, except that the photosensitive element (iv) obtained in Example 4 was changed to the photosensitive element (vii) obtained in Example 7, a substrate ④ to which (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer were laminated was prepared in the same manner as in Preparation example 7.

The resulting substrate ④ was cut and the cutting surface was observed by electron microscope. When the film forming property of (A) the photosensitive resin composition layer containing a phosphor was confirmed, it can be understood that a uniform and good (A) the photosensitive resin composition layer containing a phosphor had been formed.

[0144]

[Preparation of phosphor pattern for field emission display panel]

Example 8

<Preparation of ~~red~~ pattern>

[(I) Step of forming (A) photosensitive resin composition layer containing phosphor on substrate to which conductive layer was formed]

In the same manner as in Preparation example 7, on the substrate to which a conductive layer was formed, (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer were laminated, and then, the polyethylene terephthalate film and (B) the filling layer were removed.

[(II) Step of irradiating active light to (A) the photosensitive resin composition layer containing phosphor with predetermined image]

Then, onto (A) the photosensitive resin composition layer containing a phosphor, a photomask for test was closely contacted and active light was irradiated with a predetermined image and 500 mJ/cm² by using HMW-590 type exposure machine, available from ORC Seisakusho.

[0145]

[(III) Step of selectively removing (A) the photosensitive resin composition layer containing phosphor to which active light was irradiated with predetermined image by development]

Then, after irradiation of active light, the material was allowed to stand at normal temperature for one hour, spray development was carried out by using 1 % by weight of a sodium carbonate aqueous solution at 30°C for 120 seconds.

After the development, the material was dried at 80°C for 10 minutes, and by using Toshiba Ultraviolet ray irradiating machine available from Toshiba Denzai K.K., irradiation with an ultraviolet ray at a dose of 3 J/cm² was carried out and the material was further heated in a drying chamber at 150°C for one hour.

[0146]

<Preparation of blue pattern>

[(I) Step of forming (A) photosensitive resin composition layer containing phosphor on the substrate to which conductive layer was formed]

In the same manner as in Preparation example 8, on the substrate to which a conductive layer was formed, (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer were laminated, and then the polyethylene terephthalate film and (B) the filling layer were removed.

[(II) Step of irradiating active light to (A) the photosensitive resin composition layer containing phosphor with predetermined image]

Then, onto (A) the photosensitive resin composition layer containing a phosphor, a photomask for test was closely contacted and active light was irradiated with a predetermined image and 500 mJ/cm² by using HMW-590 type exposure machine, available from ORC Seisakusho.

[0147]

[(III) Step of selectively removing (A) the photosensitive resin composition layer containing phosphor to which active light was irradiated with predetermined image by development]

Then, after irradiation of active light, the material was allowed to stand at normal temperature for one hour, spray development was carried out by using 1% by weight of a sodium carbonate aqueous solution at 30°C for 120 seconds.

After the development, the material was dried at 80°C for 10 minutes, and by using Toshiba Ultraviolet ray irradiating machine available from Toshiba Denzai K.K., irradiation with

an ultraviolet ray at a dose of 3 J/cm^2 was carried out and the material was further heated in a drying chamber at 150°C for one hour.

[0148]

<Preparation of green pattern>

[(I) Step of forming (A) photosensitive resin composition layer containing phosphor on the substrate to which conductive layer was formed]

In the same manner as in Preparation example 9, on the substrate to which a conductive layer was formed, (A) the photosensitive resin composition layer containing a phosphor and (B) the filling layer were laminated, and then the polyethylene terephthalate film and (B) the filling layer were removed.

[(II) Step of irradiating active light to (A) the photosensitive resin composition layer containing phosphor with predetermined image]

Then, onto (A) the photosensitive resin composition layer containing a phosphor, a photomask for test was closely contacted and active light was irradiated with a predetermined image and 500 mJ/cm^2 by using HMW-590 type exposure machine, available from ORC Seisakusho.

[0149]

[(III) Step of selectively removing (A) the photosensitive resin composition layer containing phosphor to which active light was irradiated with predetermined image by development]

Then, after irradiation of active light, the material was allowed to stand at normal temperature for one hour, spray development was carried out by using 1 % by weight of a sodium carbonate aqueous solution at 30°C for 120 seconds.

After the development, the material was dried at 80°C for 10 minutes, and by using Toshiba Ultraviolet ray irradiating machine available from Toshiba Denzai K.K., irradiation with an ultraviolet ray at a dose of 3 J/cm^2 was carried out and the material was further heated in a drying chamber at 150°C for one hour.

[0150]

The sectional view of the resulting multi-colored pattern comprising red, blue and green was observed by stereomicroscope and SEM and the formed states of the multi-colored patterns were evaluated. As the results, the red-color pattern, the blue-color pattern and the green-color pattern all uniformly formed on the conductive layer side of the FED phosphor layer formed substrate on which the conductive layer and a black matrix had been formed.

[0151]

[(IV) Step of forming phosphor pattern by removing unnecessary portion from the above-mentioned pattern by calcination]

The FED phosphor layers-formed substrate in which a multi-colored pattern comprising red, blue and green had been formed on the conductive layer and the black matrix was subjected to heat treatment (calcination) at 500°C for 30 minutes to remove the unnecessary resin component to obtain a transmission type FED front panel provided with the phosphor pattern for a field emission display panel.

The sectional view of the resulting transmission type FED front panel was observed by stereomicroscope and SEM and the shapes of the phosphor patterns were evaluated. As the results, the multi-colored phosphor pattern comprising red, blue and green showed no defects in any of the three colors and formed with good adhesiveness.

[0152]

Example 9

[Preparation of transmission type field emission type display panel]

By using the transmission type FED front panel obtained in Example 8, the transmission type field emission display panel shown in Fig. 7 was prepared according to the conventionally known method.

When the resulting transmission type field emission display panel lighted by the conventionally known method, high efficiency emission luminance and uniform panel display were

observed.

[0153]

[Effects of the invention]

According to the process for producing the phosphor pattern for the field emission display described in Claim 1, a phosphor pattern for a field emission display can be formed on a substrate such as a substrate for forming a phosphor layer for a field emission display on which a conductive layer is formed with good mass productivity, high precision and uniform shape.

The process for producing the phosphor pattern for the field emission display described in Claim 2 accomplishes the effects of the invention of Claim 1 and is further excellent in workability and environmental safety.

The process for producing the phosphor pattern for the field emission display described in Claim 3 accomplishes the effects of the invention of Claim 1 and further a phosphor pattern for a field emission display having higher precision and uniform shape can be formed.

The process for producing the phosphor pattern for the field emission display described in Claim 4 accomplishes the effects of the invention of Claim 3 and is further excellent in workability and environmental safety.

[0154]

The process for producing the phosphor pattern for the field emission display described in Claim 5 accomplishes the effects of the invention of Claim 1, 2, 3 or 4, and is further excellent in workability.

The process for producing the phosphor pattern for the field emission display described in Claim 6 accomplishes the effects of the invention of Claim 1, 2, 3 or 4, and is further excellent in restraining decrease in a film thickness.

The process for producing the phosphor pattern for the field emission display described in Claim 7 accomplishes the effects of the invention of Claim 1, 2, 3, 4, 5 or 6, and is further excellent in workability and photosensitivity.

[0155]

The photosensitive element for a field emission display described in Claim 8 is excellent in restraint of edge fusion and handling property, and a phosphor pattern having high precision, uniform shape and excellent photosensitivity can be formed with good workability.

The photosensitive element for a field emission display described in Claim 9 accomplishes the effects of the invention of Claim 8 and further a phosphor pattern having higher precision and uniform shape can be formed.

The photosensitive element for a field emission display described in Claim 10 accomplishes the effects of the invention of Claim 8 or 9 and is further excellent in workability and photosensitivity.

[0156]

The phosphor pattern for a field emission display described in Claim 11 is one having high precision, uniform shape and excellent in luminance.

The field emission display described in Claim 12 is a panel provided with a phosphor pattern for a field emission display having high precision, uniform shape and excellent in luminance.

[Brief description of the drawings]

[Fig. 1]

It is a schematic view showing a partial view of one example of a substrate for forming a transmission type FED luminescent layer.

[Fig. 2]

It is a schematic view showing a partial view of one example of a substrate for forming a reflection type FED luminescent layer.

[Fig. 3]

It is a schematic view showing one example of respective steps in a process for preparing a phosphor pattern for a field emission display of the present invention.

[Fig. 4]

It is a schematic view showing one example of a step for forming a multi-colored pattern of the present invention.

[Fig. 5]

It is a schematic view showing the state in which a multi-colored pattern of the present invention is formed.

[Fig. 6]

It is a schematic view showing sectional view of one example of a transmission type FED.

[Fig. 7]

It is a schematic view showing sectional view of one example of a reflection type FED.

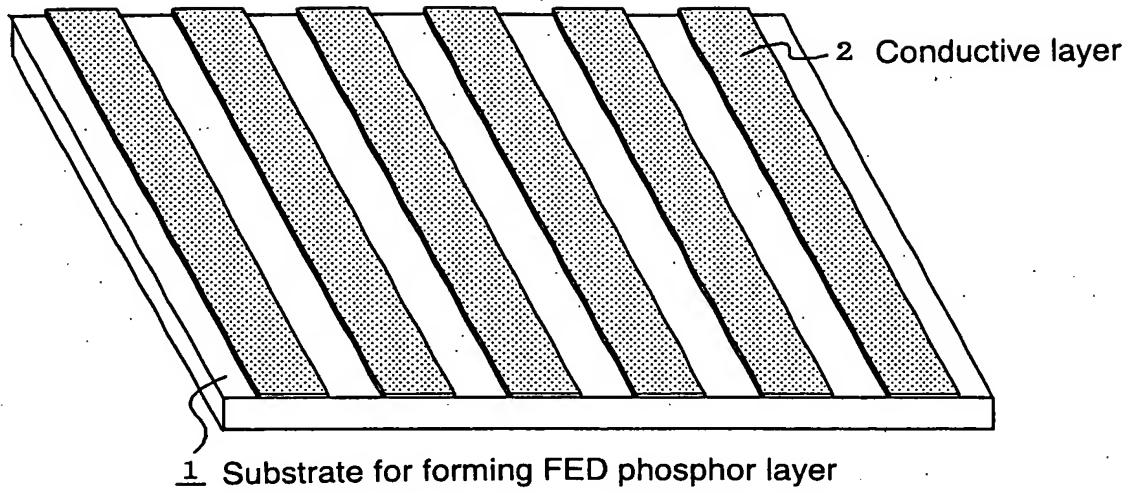
[Explanation of reference numerals]

- 1 ... Substrate for forming FED phosphor layer
- 2 ... Conductive layer
- 3 ... Black matrix
- 4 ... (A) photosensitive resin composition layer containing phosphor
- 4' ... Photosensitive resin layer containing phosphor after photocuring
- 4'a ... First color pattern
- 4'b ... Second color pattern
- 4'c ... Third color pattern
- 5 ... (B) Filling layer
- 6 ... Press roll
- 7 ... Photomask
- 8 ... Active light
- 9 ... Phosphor pattern
- 9a ... First color phosphor pattern
- 9b ... Second color phosphor pattern
- 9c ... Third color phosphor pattern
- 10 ... Emitter cold cathode
- 11 ... Glass substrate
- 12 ... Cathode
- 13 ... Resistance film
- 14 ... Back substrate
- 15 ... Target sheet

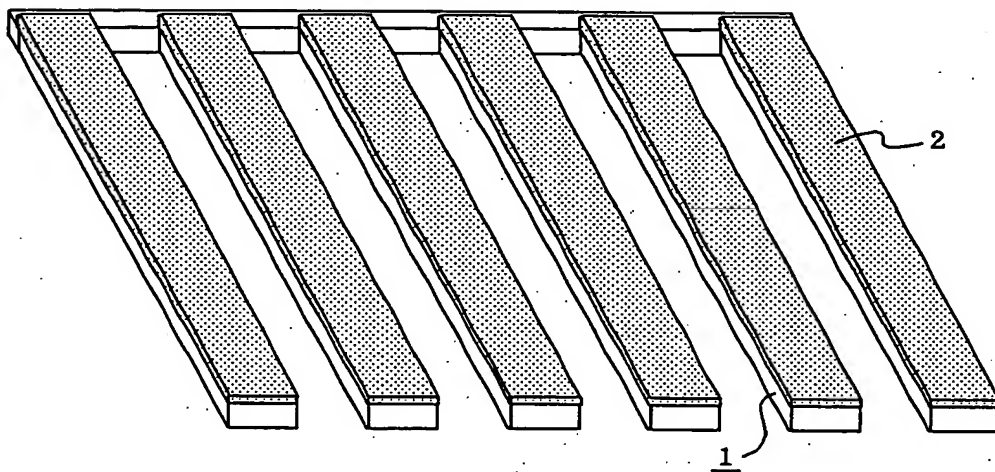
[Document Name]

Drawings

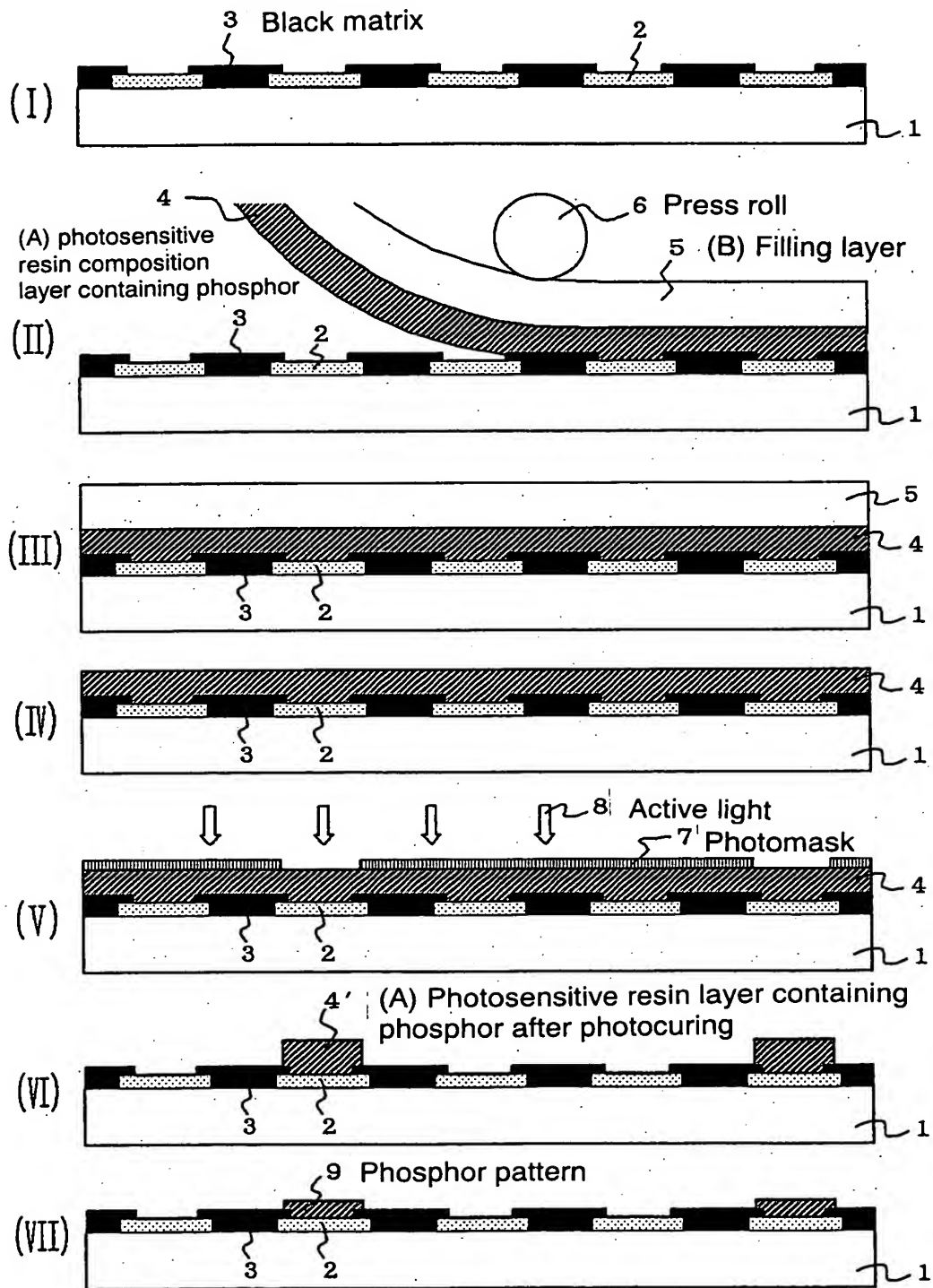
[Fig. 1]



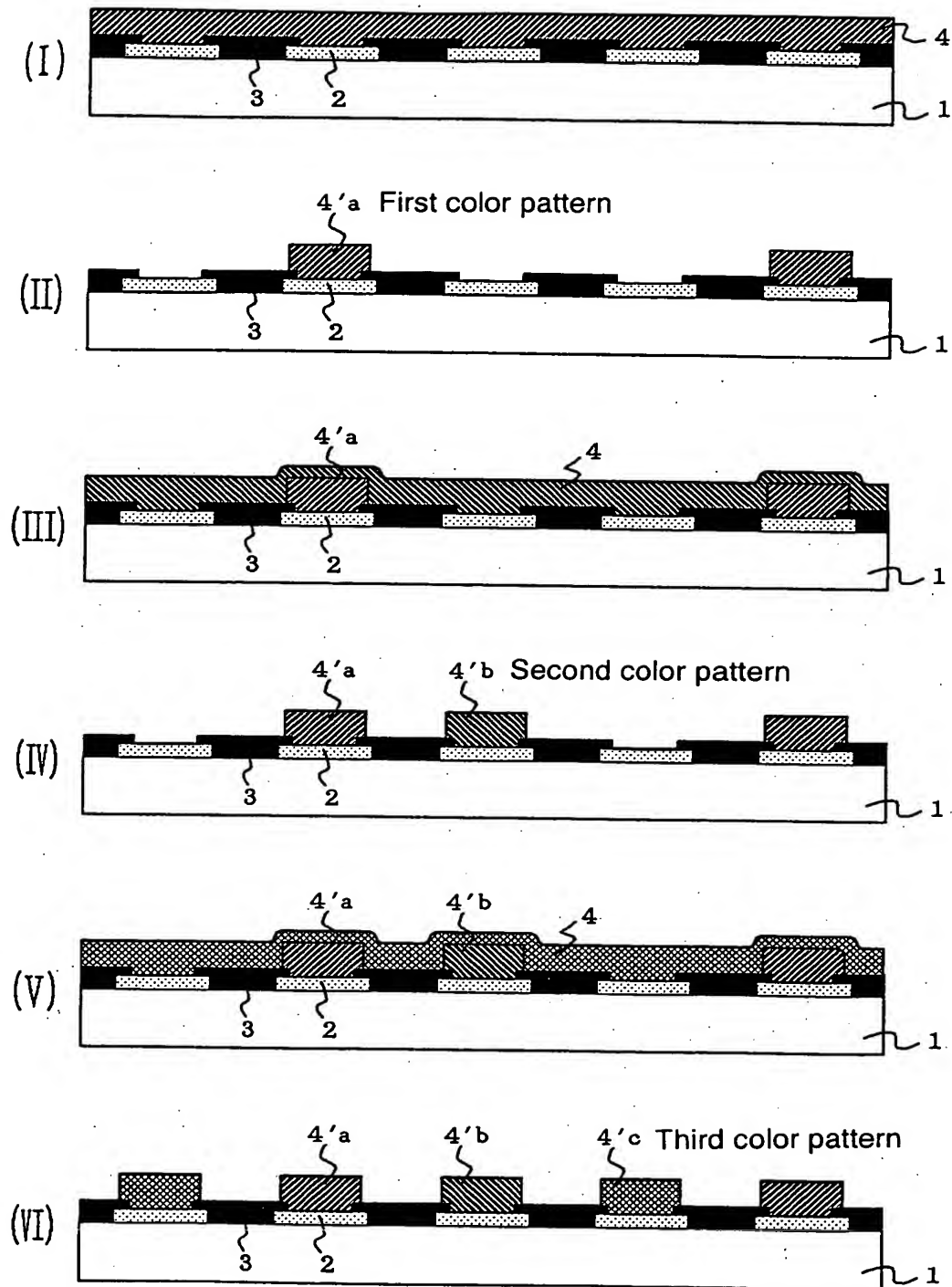
[Fig. 2]



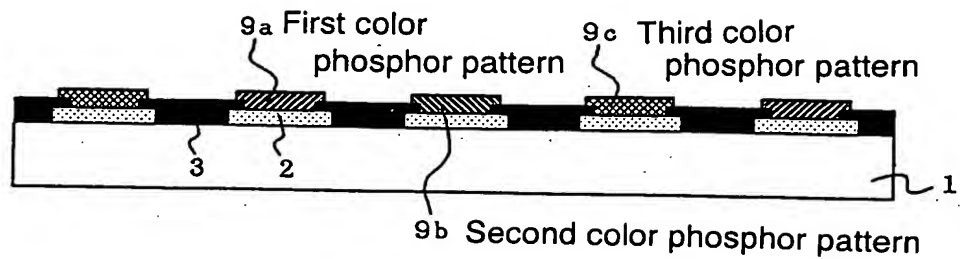
[Fig. 3]



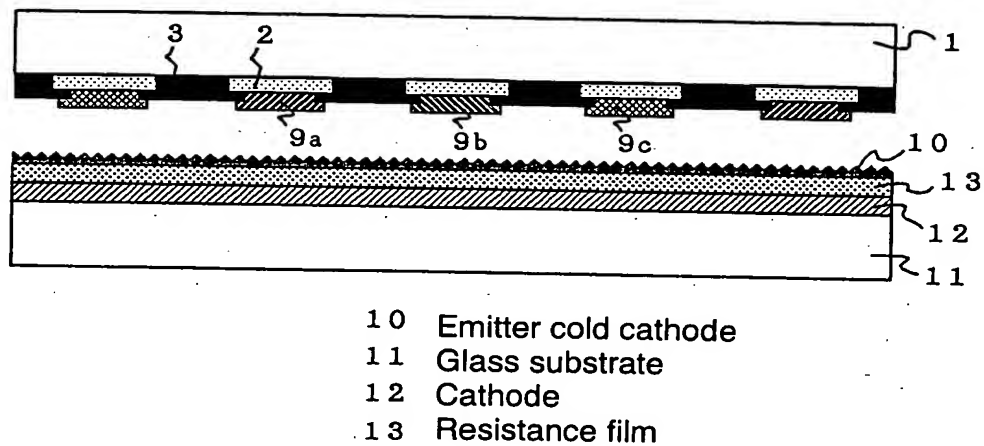
[Fig. 4]



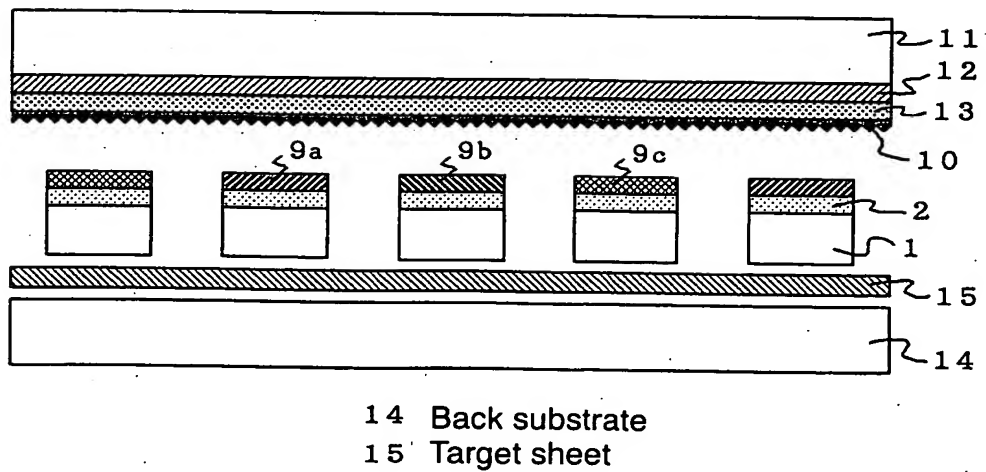
[Fig. 5]



[Fig. 6]



[Fig. 7]



[Document Name] Abstract

[Summary]

[Problem] To provide a process for producing a phosphor pattern for a field emission display in which a phosphor pattern for a field emission display can be formed on a substrate such as a substrate for forming a phosphor layer for a field emission display on which a conductive layer is formed with good mass productivity, high precision and uniform shape, a photosensitive element for a field emission display which is excellent in restraint of edge fusion and handling property, and can form a phosphor pattern having high precision and uniform shape with good workability, a phosphor pattern for a field emission display having high precision, uniform shape and excellent in luminance, and a field emission display provided with the phosphor pattern for a field emission display panel.

[Solving means] Disclosed are a process for preparing a phosphor pattern for a field emission display which comprises the steps of: (I) forming (A) a photosensitive resin composition layer containing a phosphor on a substrate onto which a conductive layer is formed, (II) irradiating active light to (A) the photosensitive resin composition layer containing a phosphor with a predetermined image, (III) selectively removing (A) the photosensitive resin composition layer to which active light has been irradiated with a predetermined image by development to form a pattern, and (IV) calcining the pattern to remove unnecessary portion to form a phosphor pattern, a photosensitive element for the above-mentioned field emission display having (A) the photosensitive resin composition layer containing a phosphor on a support film, a phosphor pattern for the field emission display prepared by the above-mentioned process for preparing a phosphor pattern for a field emission display panel, and a field emission display provided by the phosphor pattern for a field emission display panel.

[Selective figure] Fig. 3